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REAR ADM. MALCOLM F. SCHOEFFEL
New Chief, Navy Bureau of Ordnance

IN THIS ISSUE...

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The Magazine of Scientific and Industrial Preparedness

Vol. XXXV MARCH-APRIL, 1951 No. 185

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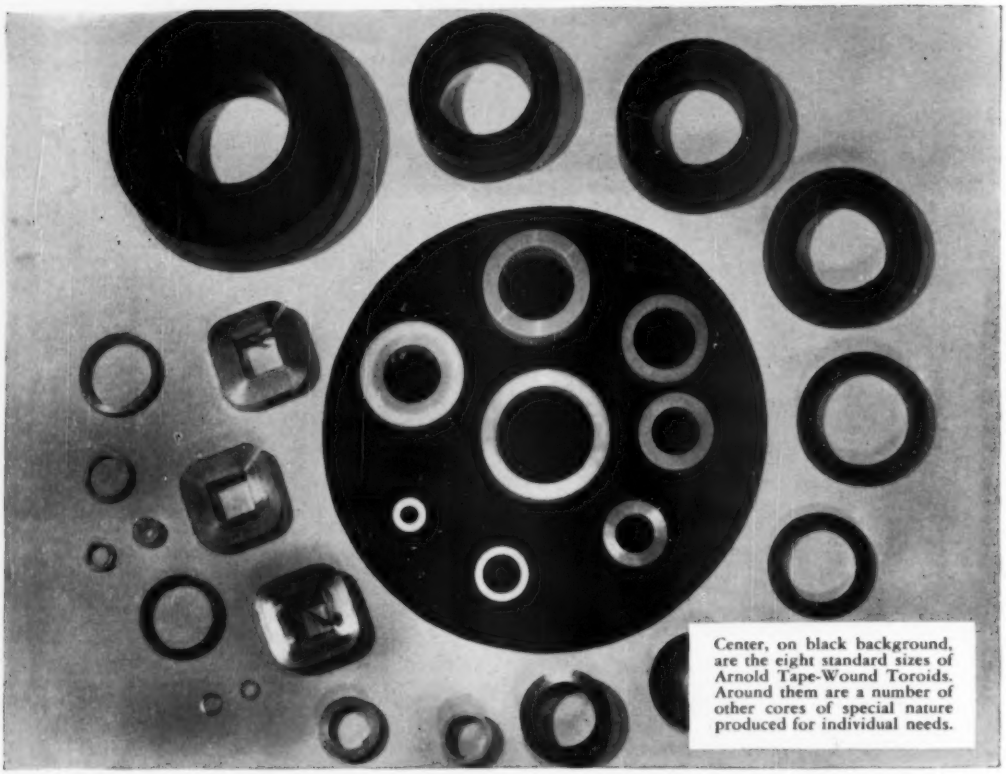

Center, on black background, are the eight standard sizes of Arnold Tape-Wound Toroids. Around them are a number of other cores of special nature produced for individual needs.

ARNOLD TAPE-WOUND TOROIDAL CORES

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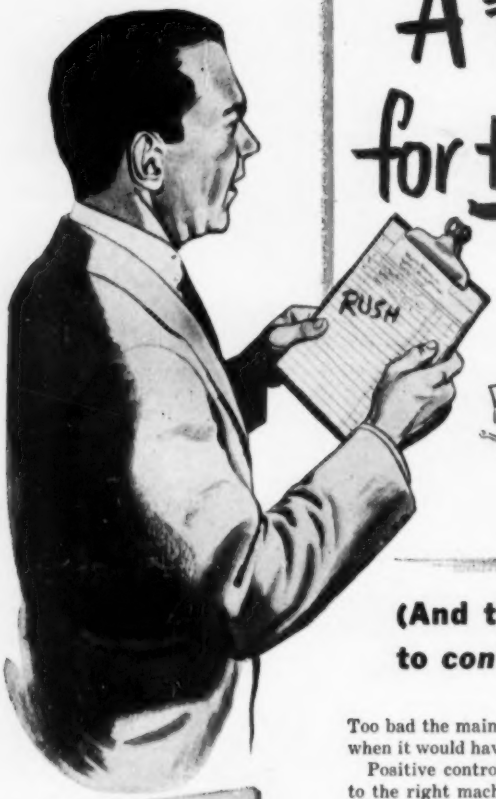

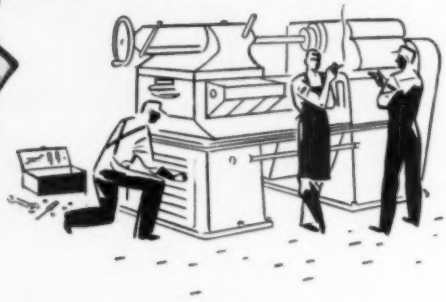

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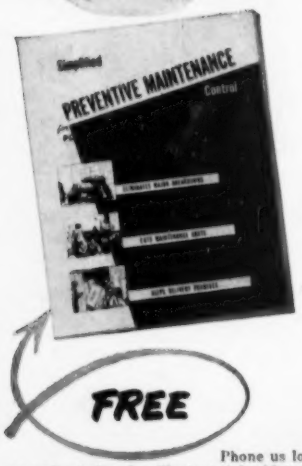

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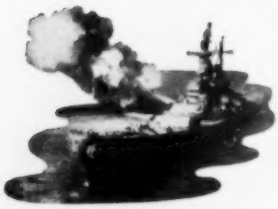

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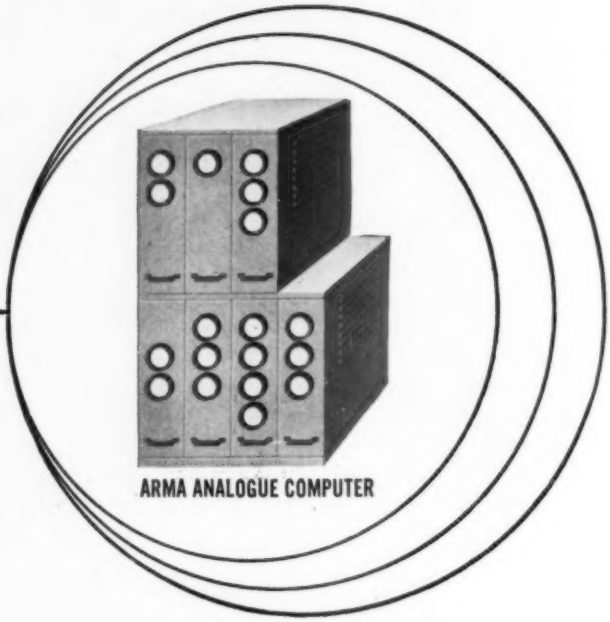

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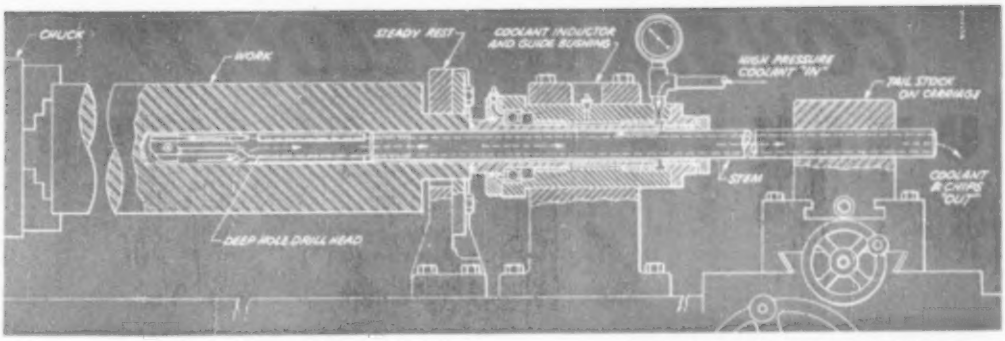

Work and tool set-up showing deep-hole drilling method

Conner Guided Deep-Hole Drill for extremely deep holes

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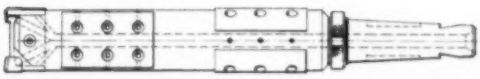
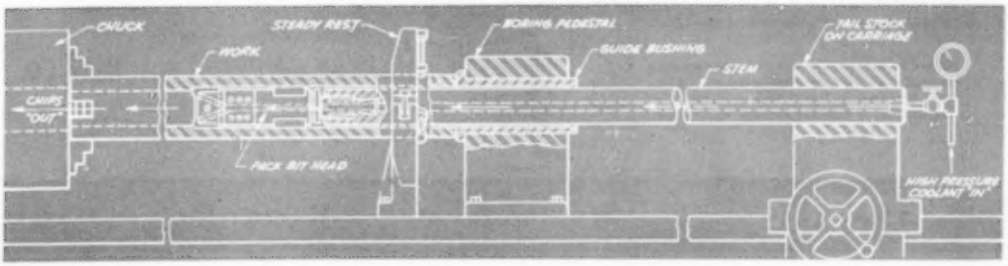


Conner Pack Bit Boring Head

Below: Set-up for boring deep holes with Pack Bit Boring Head



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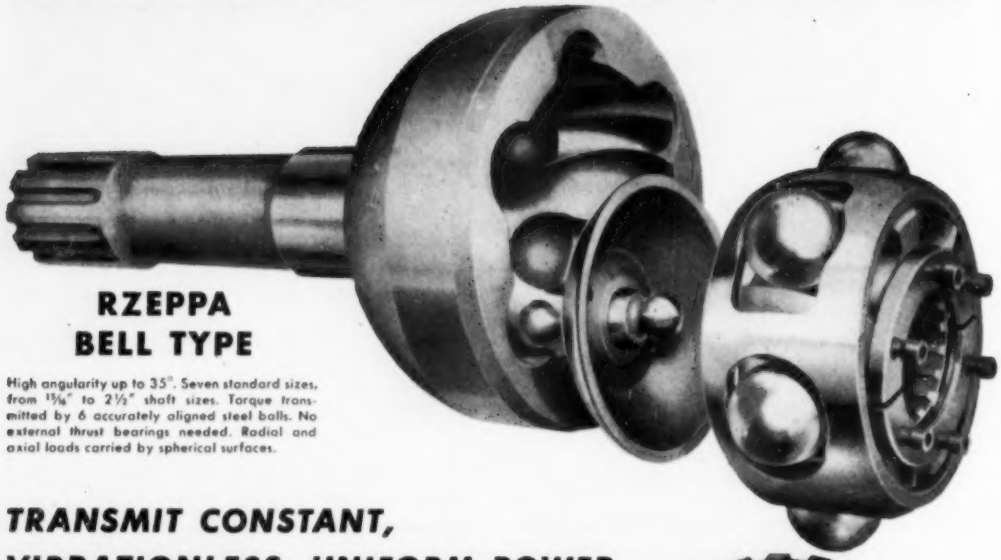

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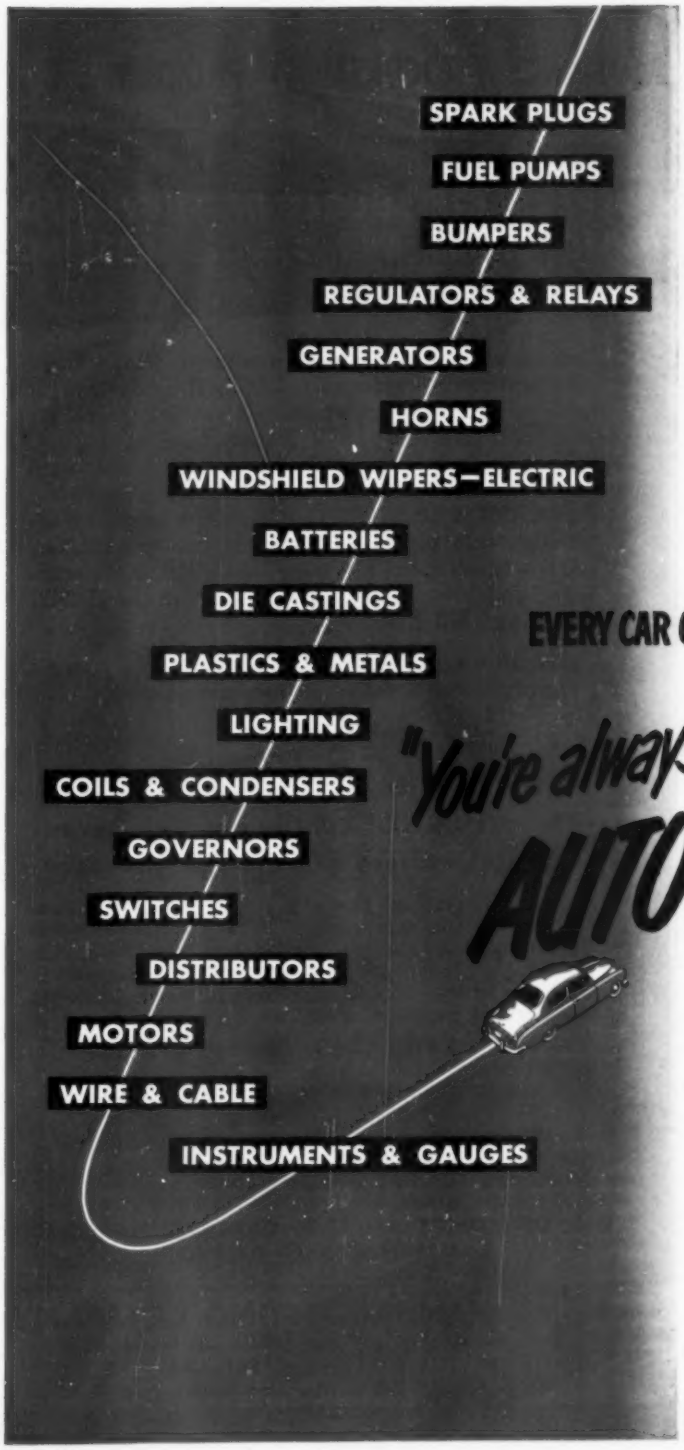

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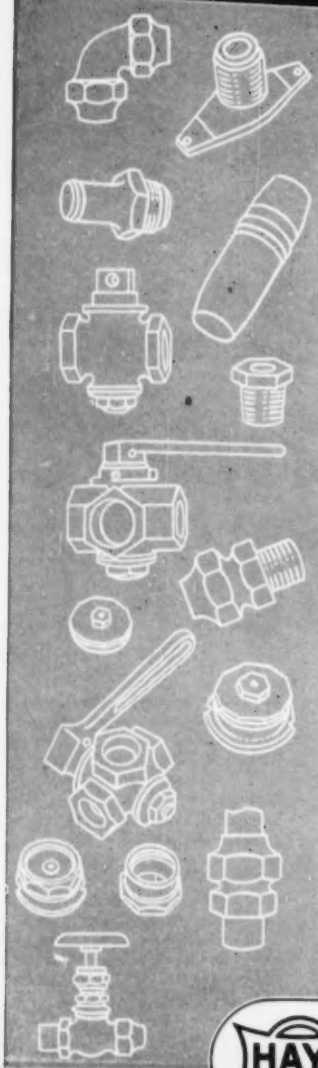

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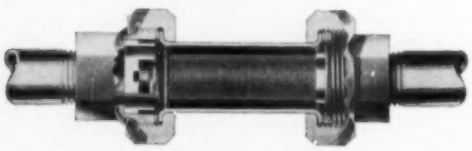

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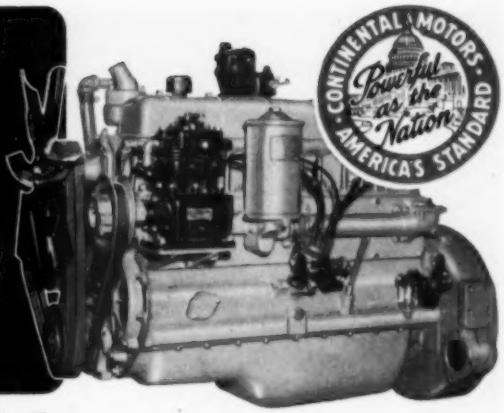
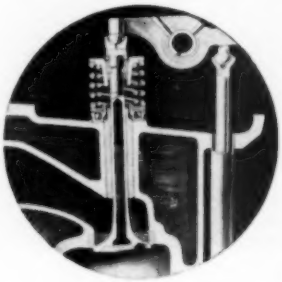
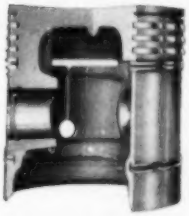


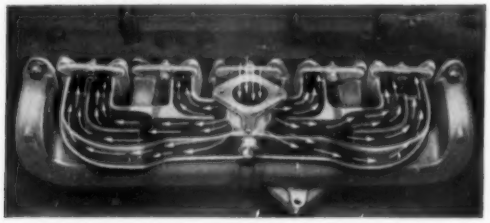
.... The T-6427



NEW, LARGER, SODIUM-COOLED EXHAUST VALVES WITH POSITIVE ROTARY ACTION prevent accumulation of carbon, and resultant power loss and damage to valve lips, seats, and springs.



CHROMIUM-PLATED TOP PISTON RING, located at maximum distance below top of piston, makes for high oil economy, and long life for cylinder bores and rings.



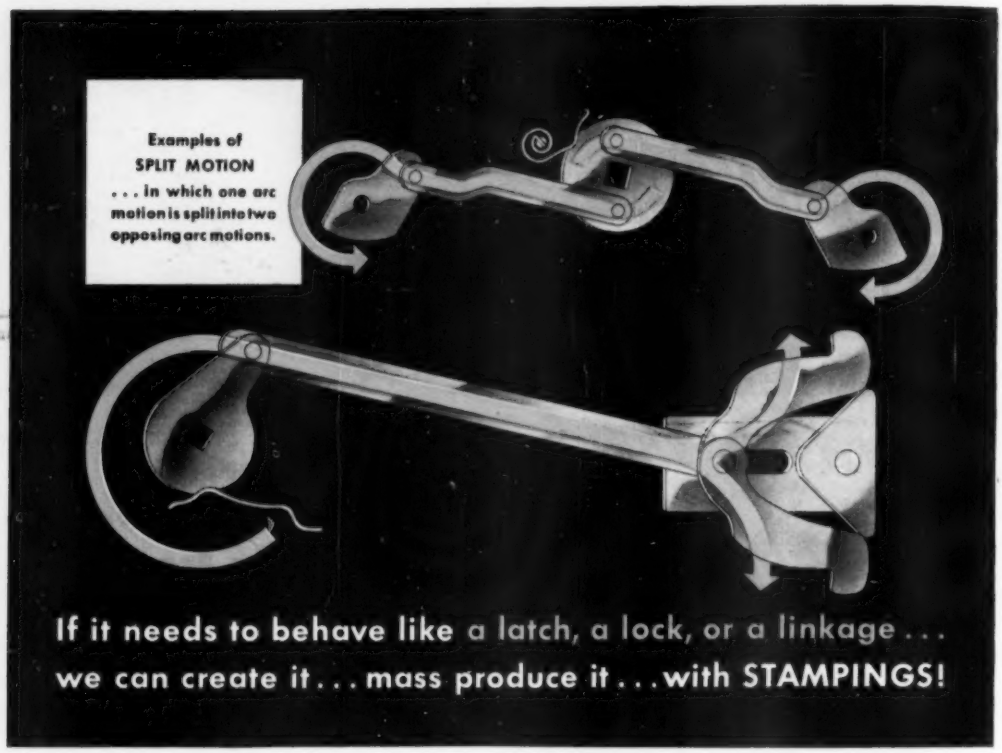
PATENTED INDIVIDUAL PORTING—This exclusive system, developed by Continental engineers, assures uniform distribution of fuel mixture to all cylinders, eliminates "loading," greatly improves thermal efficiency, and makes directional influences of carburetor and air cleaner much less critical.

Product of Engineering Know-How That Dates From 1902

It's Number One choice for those long, tough hauls—a capital transportation engine—this 1950 Red Seal T-6427. Latest in a long line bearing the same designation, it embodies features "engineeringly" balanced to achieve the performance characteristics required of modern transportation. More power, to maintain higher road speeds and minimize shifting on grades. Higher compression, for maximum power from modern fuels. Flexibility, for maneuvering in traffic. Smoother running, for economy, driver comfort, and longer engine life. For "tops" in ALL the factors that combine to cut ton-mile costs, it will pay you to investigate this latest, greatest "T", product of engineering know-how that dates from 1902. Write for bulletins and free information.

GENUINE CONTINENTAL PARTS AND FACTORY-AUTHORIZED SERVICE FROM COAST TO COAST

Continental Motors Corporation
MUSKEGON, MICHIGAN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SPLIT MOTION
. . . in which one arc motion is split into two opposing arc motions.
If it needs to behave like a latch, a lock, or a linkage . . .
we can create it . . . mass produce it . . . with STAMPINGS!

Our specialty is designing and producing sure-acting mechanical devices that initiate a force or motion, transmit it, control it or check it.

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If the type of motion used in your product has formerly required "machining-accuracy", our mass-production stamping and assembly techniques may make big cost reductions possible. Our new booklet, "We Make Motions", explains our facilities further. We'll be glad to send you a copy upon request.

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WE MAKE MOTIONS

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The key to Alcoa's technical library is a folder which lists and explains all booklets and films. Ask your local Alcoa sales office for a copy. Or write: ALUMINUM COMPANY OF AMERICA, 850C Gulf Building, Pittsburgh 19, Penna.

ALCOA ALUMINUM AND ITS ALLOYS. Fundamental information, with tabular data on chemical and physical properties, tolerances. 168 pp. 55 tables.

WELDING AND BRAZING ALCOA ALUMINUM. Manual: methods, equipment; including tungsten-arc welding. 130 pp. 52 illus. 18 tables.

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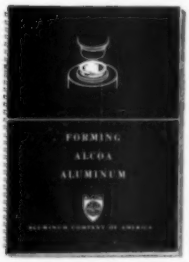

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ALCOA ALCOA ALUMINUM *First in Aluminum*

REO president Joseph S. Sherer, Jr., and Col. W. A. Call, Chief of Development and Engineering Dept., Detroit Arsenal, with the 4900th "Eager Beaver"—new Model M-34, 2½-ton, 6x6 truck for the Ordnance Dept., U. S. Army

We, at REO, are proud of our performance for the Armed Forces . . . On January 12, 1951, we completed what we believed to be the first postwar, major automotive contract, when the 4900th REO-built "Eager Beaver" rolled off our assembly lines. This order amounted to more than $30,000,000. We are currently working on another $24,000,000 "Eager Beaver" order, and we have just received two additional letter contracts which will bring our total dollar-volume on "Eager Beaver" units to more than $100,000,000.

Reo

. . . SHIP VIA TRUCK.

REO MOTORS, INC., Lansing 20, Mich.

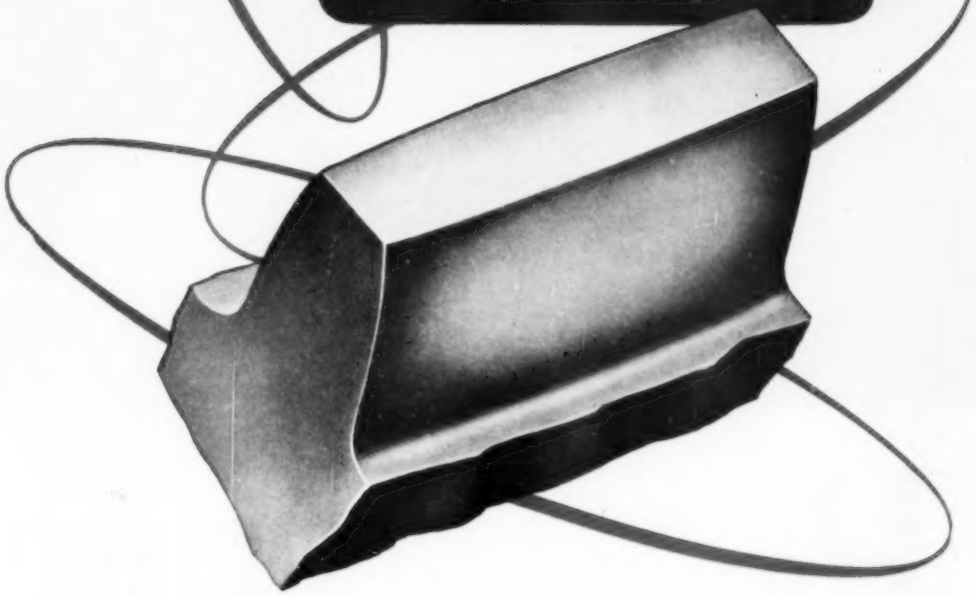
REO

TRUCKS AND BUSES

Gear Tooth Crowning

(ELLIPTOID TOOTH FORM)

A CONTROLLED PRECISION MACHINING OPERATION



Gear tooth crowning (Elliptoid Tooth Form) is used for just one purpose—to prevent "end bearing," which is a concentration of operating load at the end of the tooth where it is most vulnerable to failure.

Crowning is the only way to prevent end bearing because with any gear assembly it is impossible to maintain accurate gear alignment under all conditions of loading. Shafts, bearings and mountings are all elastic. Even the slightest deflection will cause misalignment and end bearing in gears with conventional teeth.

Many of the leading automotive gear plants have standardized on crowning to raise the factor of safety of gear teeth and to reduce operating gear noise. Crowning does both successfully.

Crowning accomplished on Red Ring Gear Shaving Machines is a precision machining operation by which the maximum amount of crown is always under positive control. Tolerance control is indicated by a typical routine check of a lot of 4000 gears having the following specifications: 1" face, 18 teeth, 13.5 Nor D.P., 20° Nor P.A., 27° H.A. and .0003" to .0005" crown. An adequate check failed to reveal any unit outside the .0002" tolerance on crowning.

WRITE FOR BULLETIN S49-5 FOR A MORE DETAILED DISCUSSION OF GEAR TOOTH CROWNING

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORM

5621

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It means the *continuous* development and improvement—in *peace* as well as in war—of *specialized* equipment specifically engineered to give it maximum usefulness for America's Armed Forces.

Timken-Detroit engineers are constantly at work, year after year, refining axles, brakes and other vehicle components to simplify and standardize all parts and bring about the highest possible degree of interchangeability.

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At Timken-Detroit the defense program is a permanent phase of this Company's activities—last year, this year, next year, *every year!*

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A PRODUCT OF THE TIMKEN-DETROIT AXLE COMPANY

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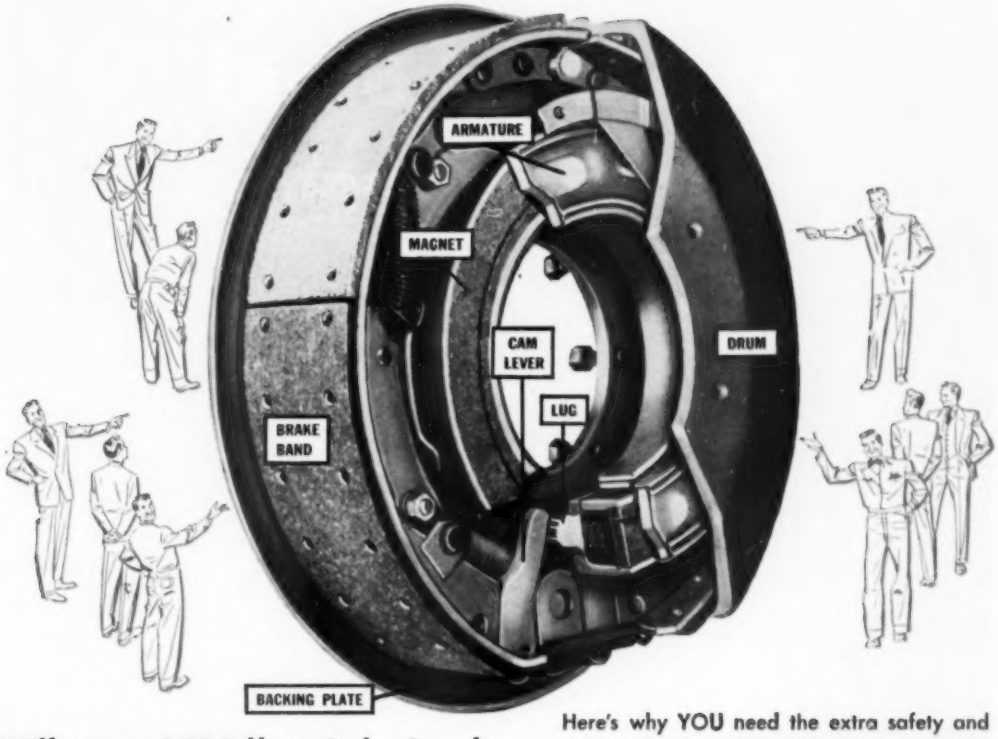
Announcing A New 15" x 3"

WARNER ELECTRIC BRAKE of ADVANCED DESIGN



Will stop 8000 lbs. Axle Loads Using 7.50x20 Dual Tires, Provides 116 sq. inches of Working Lining.

This new powerful Warner Electric Brake of two shoe construction, incorporates the most advanced brake engineering — gives you an entirely new margin of safe, effective, stopping power. Fits 18" and 20" wheels on all types of trailers — semi, cargo, pole, logging, auto transport and utility. Rigid and rugged well beyond the axle loads and sizes for which recommended. And no brake but the Warner Electric Brake offers you the fast-acting, smooth controlled braking power — power developed within the brake itself — that this great new brake gives you. Warner Electric Brakes have been performance-proved by leading tractor-trailer operators during 23 years of efficient, dependable service. Standardize on Warner Electric Brakes in your fleet. Write for information on the full line.

WARNER ELECTRIC BRAKE & CLUTCH CO.
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Here's why YOU need the extra safety and protection only Warner Electric Brakes give!

Only two flexible wires required from truck battery to the brakes.

Sturdy cable connection from truck to trailer makes all electrical contacts.

Only Warner Electric Brakes offer complete synchronization with hydraulic or air-braked tractors.

"Vari-Load" dial on dash presets correct braking power.

There's nothing to get knocked-off, freeze, split or break . . . nothing to come loose, rattle and bang.

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THE ORIGINAL AND PROVEN
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Gauges, ¼ in. to 3 in. Inclusive.

Fully Heat-Treated, Machined, Formed.

Ready for Welding.

For Tanks, Self-Propelled Gun Mounts, Vehicles.

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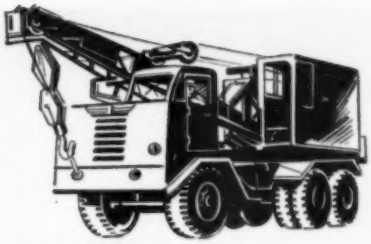
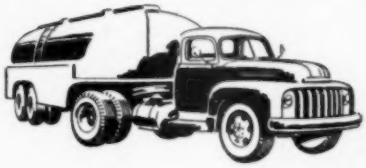


On Any Hauling Job

the best brake is AIR...



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BENDIX-WESTINGHOUSE AIR BRAKES
GENUINE
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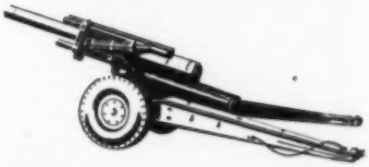
Bendix-Westinghouse



Performance Proven in World War II and Accepted by Ordnance Men Everywhere for

- ★ RELIABILITY
- ★ SAFETY
- ★ LESS MAINTENANCE
- ★ ECONOMY
- ★ FASTER SPEEDS . . . GREATER CONTROL
- ★ DRIVING COMFORT

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY, Elyria, Ohio

Freedom from Care

WITH NEW DEPARTURE BEARINGS

The concept of
cutting maintenance
and increasing life
in mechanisms
by new bearing design
originated with
New Departure

The lubricated-for-life
ball bearing. Ask for it.

Nothing Rolls Like a Ball...

NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE · DIVISION OF GENERAL MOTORS · BRISTOL, CONNECTICUT

124

NOW – An amazing new wood that resists fire!

Looks like ordinary wood, you say? Well it is wood. But not ordinary! It's a new kind of wood. Koppers has pressure-treated it with certain chemicals.

So what? So ordinary wood becomes amazingly different. It has far greater resistance to decay. It is completely unpalatable to termites. And get this: it is *fire-retardant!*

Yes, wood has joined the fire-safe materials! This Koppers Fire-Retardant Wood greatly reduces all fire hazards . . . has a high degree of resistance to the attacks of fire itself.

Thus, to all the advantages of wood . . . its easy workability, availability, decorative value, economy, re-use value . . . are added resistance to decay and termite attack as well as resistance to fire. Yet the odorless Koppers treatment does not harm the color or paintability of the wood.

This amazing new wood that won't burn is ideally suited for floors, roofing, sheathing, and the structural members of plants, warehouses, docks, railroad engine houses, bridges, tunnel linings and similar structures. For more complete data, send for *Koppers Fire-Retardant Wood,* a new booklet containing interesting, helpful information about this latest development in pressure-treating wood.

KOPPERS COMPANY, INC. · Pittsburgh 19, Pa.

KOPPERS **PRESSURE-TREATED WOOD**

COMMUNICATIONS

WELCOME TO JOE DOPE

THE EDITORS.—I have noted with great interest your article on page 204 of the November-December issue of ORDNANCE. "Joe Dope" has been my favorite, ever since *Army Motors* days, in selling our constant product of preventive maintenance to the using units.

I want to say that it is a continuing pleasure to be a member of the A.O.A., and I get the same reports from my Dad in Cincinnati who joined only a few months ago but already is taking an active part in things. The entire section looks forward as I do for the journal and the bulletins.

CAPT. THOMAS E. HAUSS
Assistant Operations Officer

Ordnance Section,
Hq. Seventh Army,
Germany

ARMORY DONATED

THE EDITORS.—W. C. MacFarlane, president of Minneapolis-Moline Company, is president of the Northwest Post of the American Ordnance Association. Attached is a copy of a letter which he has written to M. Sgt. H. G. Ordemann who for a number of years past has been very active in training an Ordnance unit sponsored by Mr. MacFarlane's company.

You will note from the letter that further activity has now been brought into play in opening the armory facilities of the company, located in one of the suburbs.

R. F. WILSON
Secretary, Northwest Post, A.O.A.

Minneapolis, Minn.

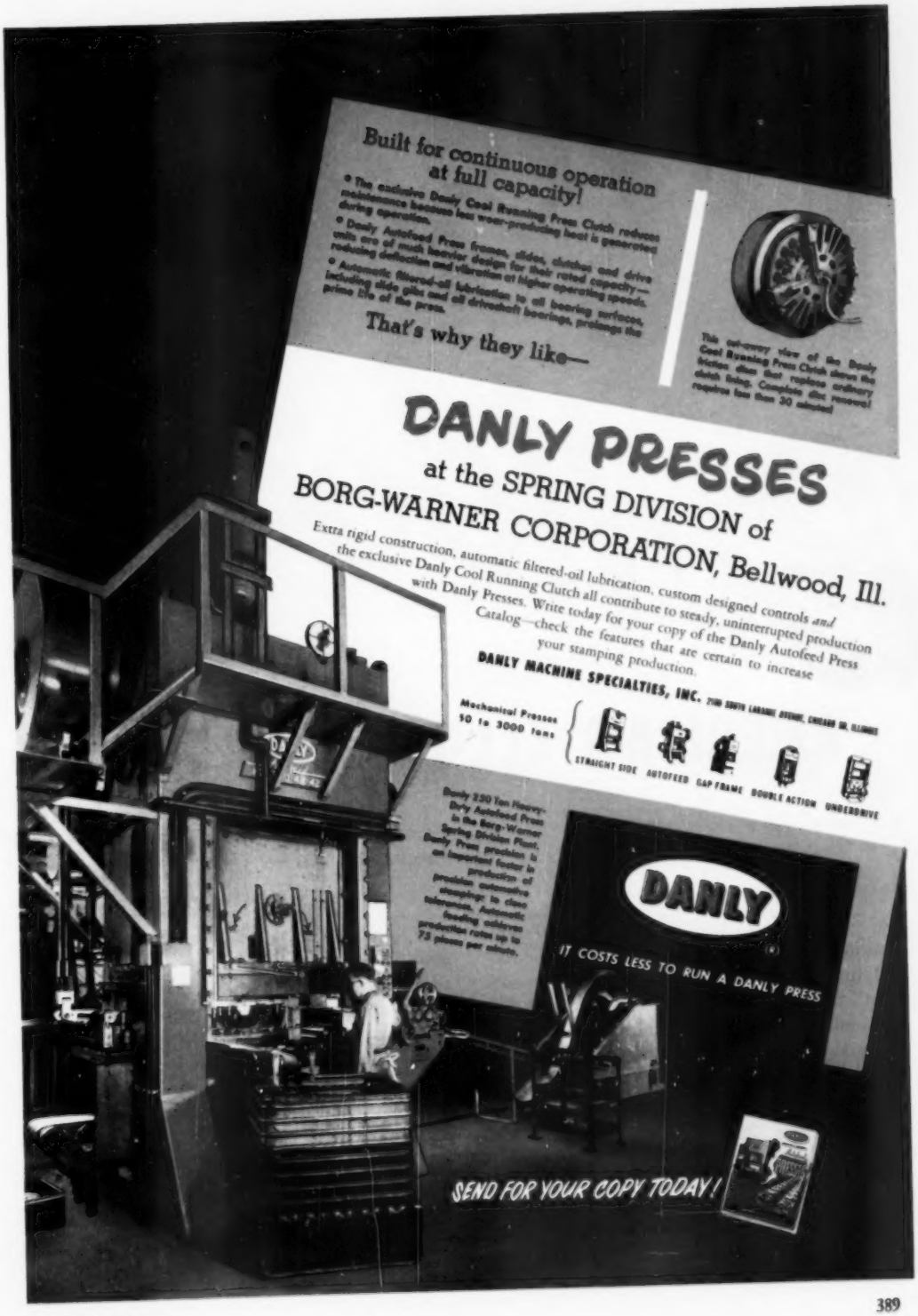
M. Sgt. Harold G. Ordemann,
Organized Reserve, Army,
Fort Snelling, Minn.

Dear Sergeant Ordemann.—Pursuant to a verbal agreement between Sgt. Harold G. Ordemann and myself, permission is hereby granted for him to bring such additional personnel to the Minneapolis-Moline Armory located at 4020 Minnehaha Avenue, Minneapolis, for training as the facilities will accommodate during this temporary emergency and until further notice.

This in no way abrogates the privileges of the Minneapolis-Moline Company in connection with the control of the building and continuing partial occupancy.

W. C. MACFARLANE
President and General Manager
Minneapolis-Moline Company

Minneapolis, Minn.


Built for continuous operation at full capacity!
• The exclusive Danly Cool Running Press Clutch reduces maintenance because less wear-producing heat is generated during operation.
• Danly Autofeed Press frames, slides, clutches and drive units are of much heavier design for their rated capacity—reducing deflection and vibration at higher operating speeds.
• Automatic filtered-oil lubrication to all bearing surfaces, including slide gibs and all driveshaft bearings, prolongs the prime life of the press.
That's why they like—
This cut-away view of the Danly Cool Running Press Clutch shows the friction disc that replaces ordinary clutch lining. Complete disc renewal requires less than 30 minutes!
DANLY PRESSES
at the SPRING DIVISION of
BORG-WARNER CORPORATION, Bellwood, Ill.
Extra rigid construction, automatic filtered-oil lubrication, custom designed controls and the exclusive Danly Cool Running Clutch all contribute to steady, uninterrupted production with Danly Presses. Write today for your copy of the Danly Autofeed Press Catalog—check the features that are certain to increase your stamping production.
DANLY MACHINE SPECIALTIES, INC.
Mechanical Presses 10 to 3000 tons
STRAIGHT SIDE
AUTOFEED
GAP FRAME
DOUBLE ACTION
UNDERDRIVE
Danly 250 Ton Heavy-Duty Autofeed Press in the Borg-Warner Spring Division Plant. Danly Press precision is an important factor in production of precision automotive stampings to close tolerances. Automatic feeding achieves production rates up to 75 pieces per minute.
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IT COSTS LESS TO RUN A DANLY PRESS
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"Cat" Bulldozer

AMERICA'S ALL-PURPOSE TOOL

WHEN this "Caterpillar" D8 Tractor with matching No. 8S 'Dozer leans into loose rock and turns on the power, you get quick results. "Cat" Bulldozer means long service life and best job results in 48 states and as many different types of work. And it's why you see so many "Cat" Bulldozers doing important routine, or emergency jobs, at military installations throughout the nation. For whether it's speeding up the production of essential ores and lumber, or doing a strictly military job, these matched units are prime tools for keeping America strong.

"Caterpillar" Bulldozers give you matched design—tractor and 'dozer are built to work together. This rugged team is a bear at meeting work schedules. Sturdy construction and quality materials enable it to keep punching full time without downtime, and the special steel cutting edge of the blade hammers through the toughest going. Most important of all, the precision methods used in "Caterpillar" factories build extra years of life into this highly maneuverable equipment.

The same toughness and reliability which make this power package preferred by industry recommend its use on military projects—from chunking out an airstrip to powering a Gil-hoist during amphibious operations.

CATERPILLAR, PEORIA, ILLINOIS

This "Caterpillar" Diesel D8 Tractor with No. 8S 'Dozer is doing road construction on the Valley Highway, new expressway across Denver, Colorado—addition to America's vital network of highways.

"CATERPILLAR" BULLDOZER EXTRA FEATURES

1. Tractor and 'dozer *broken to harness*, and a size for every need.
2. Moldboard curvature for active, *rolling*, higher production loads.
3. Box section side arms—extra thick at points of greatest stress.
4. Choice of straight or angling type of blade, simple to maneuver and easy to adjust or detach.
5. Your choice of hydraulic or cable controls.
6. The power of the "Caterpillar" Diesel Engine is geared to blade *capacity*.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

Modern Naval Ordnance

New Weapons Meet the Challenge of High-Speed Warfare

THE Navy's new antitank aircraft rocket, called the "Ram," was specifically designed to destroy Soviet tanks in Korea. It was developed, tested, and produced in only twenty-two days at the great Naval Ordnance Test Station at Inyokern, Calif.

The powerful new weapon represents a highly successful advance over the conventional 5-inch high-velocity aircraft rocket. It carries a 6.5-inch shaped-charge head and can be fired with deadly accuracy from any plane equipped with a suitable rocket launcher.

Air Power Modernized

A good part of Navy aircraft and naval aircraft ordnance employed so successfully in World War II is today obsolescent. Naval air power, as a consequence, is being completely modernized—and with highly creditable results. Navy jet engines, for example, have the smallest frontal area-thrust ratio and the best weight-thrust ratio of any turbojet engines in the world.

The high performance of new aircraft created serious problems of airborne weapon control. To solve the problem of finding, recognizing, and tracking fast-moving targets, the Navy developed automatic equipment to aid the pilot when traveling at 500 to 600 miles an hour at an altitude of 50,000 feet.

An air-to-air rocket with folding fins, the "Mighty Mouse," was developed for use on modern high-speed aircraft. The folding fins permit more compact stowage and allow a greater number of rockets to be carried. This rocket is a powerful addition to the weapons of interceptor or fighter aircraft in attacking large high-speed planes.

For upper-air research the "Aërobee" and the "Viking" missiles were developed by Navy Ordnance. Outstanding results have been achieved with these missiles aboard the NORTON SOUND, a converted seaplane tender—now the country's first floating guided-missile proving ground.

Research and development programs are being accelerated to develop radically new antisubmarine warfare weapons and to provide for the modernization and more effective utilization of existing equipment. A new type of torpedo, for use from surface ships and submarines, is now in production. The Navy has also developed a new shipboard launcher, capable of firing antisubmarine rockets with improved underwater ballistics at a high rate of speed.

Work is going forward rapidly on the development of full-automatic intermediate-caliber rapid-fire antiaircraft guns, with accompanying improved fire-control systems. These high-velocity weapons will give the fleet the strongest possible antiaircraft defense.

The Navy Bureau of Ordnance works in close coöperation with many industrial organizations and with the scientific departments of many of America's leading universities.

Coöperation between Navy Ordnance and Army Ordnance has been a long-standing tradition. Since before World War I there has been a close and cordial working relationship between the two services, resulting in the design, development, and production of a number of important ordnance items for use by both services.

Preparing for Production

During the past few years the Navy has engaged only in limited production on modernized or new prototype weapons, principally for evaluation purposes. Today the Navy, while speeding up research and development projects, is preparing for mass production.

The Nation is highly fortunate in having the naval ordnance leadership of Admiral Schoeffel because his familiarity with all phases of an integrated ordnance program is accompanied by a firsthand knowledge of combat conditions and requirements. He is carrying on the high standards of leadership set by Vice Adm. Albert G. Noble, former Navy Ordnance Chief, now Chief of Naval Material.

Rear Adm. Malcolm Francis Schoeffel, the first naval aviator to be appointed Chief of the Navy Bureau of Ordnance, is a veteran of both World Wars. Born in Rochester, N. Y., he was graduated from the U. S. Naval Academy with distinction, first in his class, in 1918. His picture appears on the front cover of this issue.

Assigned duty with the Destroyer Force, he saw battle action against German subs in the North Atlantic in the First World War. Returning to the United States in 1921, he volunteered for flight training and joined the air squadrons of the Pacific Fleet.

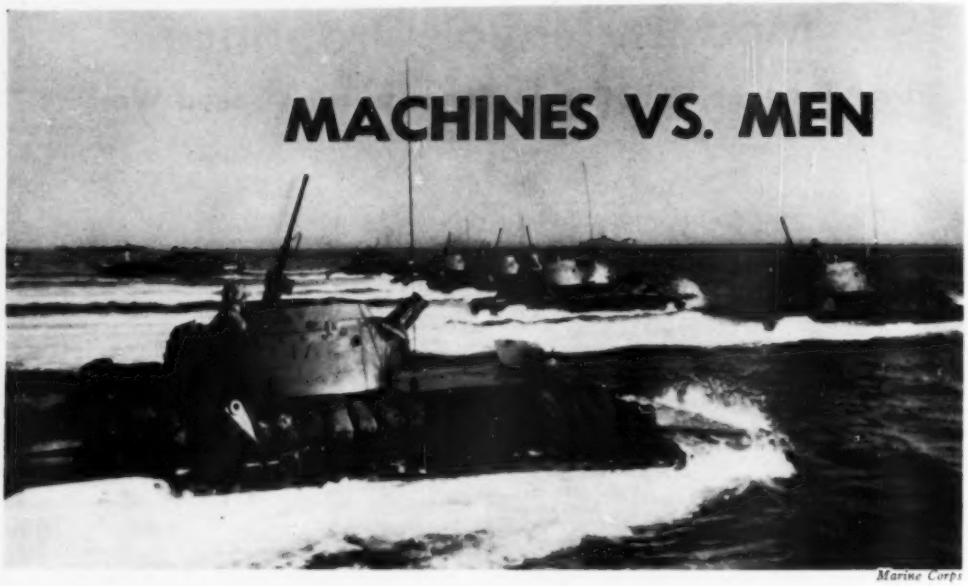
In 1941 Admiral Schoeffel became Assistant Director of Aviation Ordnance in the Research and Development Division of the Navy Bureau of Ordnance. He directed improvements that added considerable striking power to our battle fleet, receiving the Legion of Merit for outstanding services.

During World War II, Admiral Schoeffel was in command of the carrier CABOT. As a member of famous Task Force 58, he took part in many air strikes in the Marshalls and other Pacific islands.

In 1946 he was appointed Deputy Chief and Assistant Chief of the Bureau of Ordnance. Another tour of sea duty, in command of Carrier Division 6, was followed by shore duty as commandant of the Naval Air Test Center at Patuxent, Md. He assumed his present important post in December 1950.

ARMORER AT WORK *loading rockets on the wing racks of an F4U aboard an* ESSEX*-class aircraft carrier "somewhere at sea" (Navy photo).*

MACHINES VS. MEN



Marine Corps

Weapons Must Be the Slaves and Not the Masters of Tactics

by

Marshall Andrews

America's military weakness lies in her persistent tendency to discount the rôle of man in warfare and to send him into battle unprepared to make the most of the fine weapons it places in his hands.

IT is not surprising that a nation whose life is altogether dependent upon the products of industry should look to industry to preserve it from military disaster. Yet this reliance on some *deus ex machina* under the threat of war could, if carried too far, prove our undoing.

Slave to Machines

The American has become the slave of his mechanical contrivances. His birth is broadcast by television. He is raised on food mechanically planted, cultivated, and harvested and brought to his table mechanically cooked and tinned. He moves throughout his life on power-driven wheels, and, when finally he dies, he is whisked off in a

motor-hearse to be lowered mechanically into a grave scooped out by a power shovel.

When so much of the labor of living is done for him by machinery, he can hardly be blamed if he expects machines to do his dying for him in war.

The fallacy in this hopeful thinking begins when your American discards the fact that his multiplicity of machines has, in turn, forced creation of a great peacetime force of skilled labor without which his machines could not be built, maintained, and operated.

Likewise, the advent of machines into warfare has not decreased but rather has increased the need for men and has expanded the burden upon the individual man beyond the comprehension of the soldier of a generation ago.

Mr. Andrews is a well-known Washington correspondent and military analyst. He is the author of "Our New Army" and "Disaster through Air Power."

Men Not Supplanted

Modern armies, therefore, though they may travel on wheels, encased in armor from which they spray the enemy with fire from a dozen ingenious weapons, have not substituted machines for men. As machines and weapons are multiplied, so are the armies' logistical problems, for as machines consume fuel and weapons consume ammunition their gargantuan appetites must be sated by men laboring in lines of supply which have grown longer and fatter with the increase of mechanization in warfare.

Thus mechanization has inevitably increased the need for "mass" armies, if you accept that term in the strategic rather than the tactical sense. And in the deployment of those armies on the battlefield no one has felt the impact of mechanization less than the soldier committed to the final issue of ground combat.

"He still took," wrote Col. S. L. A.

Marshall, "the final chance of life and death in the same old dreary gamble, and all of the wonders of science had not lifted any of the pain and loneliness from his heart."

True, the increase in automatic weapons has reduced rather than (as has been assumed) increased the percentage of casualties to total men in uniform, and that is due no less to dispersion on the battlefield than to the burgeoning lines of supply. And, equally true, mechanization has brought comforts to the man in battle hitherto undreamed of, but it also has made possible his retention in sustained combat beyond the powers of human endurance.

The paradox in the unremitting search for and application of new means of wholesale killing is that each bears within itself the solution to whatever new problems it poses.

Thus, automatic weapons force battlefield dispersion which, in its turn, calls for more and better automatic weapons, creating further dispersion, until the cities where the weapons originate become themselves the targets.

And on Napoleon's principle that "when you can use the lightning, 'tis better than cannon," man pursues his search for more terrible weapons until he unlocks the darkest secrets of nature and turns her most destructive forces against himself.

Means without an End

And in doing all this he has, in the final analysis, created for himself a means without an end. For no matter what devastation he visits upon an enemy and himself receives in return, the issues will not be decided until the enemy's armies, which may hold sources of weapons and food independent of his own cities, have been destroyed.

To put it another way, as long as the enemy rests his cause upon an army in being, that army must be the target, and all effort expended elsewhere is but supplementary.

In attacking this army, weapons of increasing complexity and effectiveness will always, of course, have their part. But they can no more be brought into play without the guiding hand of man than the axe alone can venture into the forest and hew down a tree.

By reason of their increase in complexity as well as in quantity the new weapons demand not only the greater numbers of rear-echelon technicians already mentioned but in even greater measure more men—more intelligent and more thoroughly trained—to make the most of them in battle.

The simple truth is, and no measure of hope or despair can alter it, that the intelligent and imaginative application of manpower on the battlefield will continue to be the solution to the demands of military force. It is in this application of manpower that the new weapons have had, and in the future will have, their most important effect.

For the increased range, accuracy, and power of weapons has necessitated dispersion and depth in the place of the old linear tactics. As a consequence, demands have been imposed upon the soldier which nothing in civilian life prepares him to accept. Neither he nor those at home, whose attitude does so much to determine his state of training, can comprehend these demands until he has come face to face with them on the battlefield.

There are a few ancient gaffers among us now who can remember war as it was in the brave days of flags and bugles and charges in lines "dressed as though on parade" against solid ranks of defending soldiery. Everybody's task under those conditions was relatively simple. The officer had his entire command under his eye and within range of his voice. The soldier had only to obey and, in those moments of panic which come to all men on the battlefield, he had the reassuring presence of friends to his right and left.

"By reason of their increase in complexity as well as in quantity the new weapons demand not only a greater number of rear-echelon technicians but in even greater measure more men —more intelligent and more thoroughly trained—to make the most of them in battle."

All that is changed now, and modern weapons have changed it. The soldier himself, with his weapons, has become a tactical unit. Not only is he that, but to no small extent he has become his own battlefield commander. Except in the most general and distant sense, there is no longer any one to tell him what to do and when to do it, to lead him to his place on the ground, to point out his target and tell him when to fire and when not to fire, or to inspire him when he falters.

Must Decide Alone

Most of these decisions he must make alone, and his life and that of his country may depend upon how well he makes them.

All these things he must do for himself amid the most terrifying and heart-shaking isolation the cruelty of man has yet devised. He must learn at least once the lesson which General Grant considered the most important in his career: that the enemy fears him as much as he does the enemy. And while he is doing these things he may expect to know but little of what is going on except within the few cubic yards encompassed by his own eyes and ears. His infrequent and fleeting contacts with his fellows may well serve but to increase the confusion which already envelops him.

This, then, is the principal result of the new weapons which so many of us would like to believe have freed man forever from the ordeal of the battlefield. If they have but served to increase the length and intensity of this ordeal, it will serve no purpose to persist in denying the fact.

Yet we do persist in denying it. The mechanization which has become so much a part of our daily lives has led us so far from the truth that we have substituted for the actualities of warfare an impossible chimera in which war is reduced to nothing but destruction with all the risks taken by machines.

The idea (I cannot call it "thought") has even been advanced that training of soldiers should give way to mass training of scientists to fight our wars for us with test tubes and Bunsen burners.

Almost daily do we hear the thesis advanced that the enemy's "mass" armies cannot be defeated, that only by sitting securely on our own continent and firing machines at his cities can we defeat him. A distinguished educator, Dr. Alonzo F. Myers, stated it recently for perhaps millions when he wrote in *Parents* magazine that "it is our industrial potential and our research, development, and production of military weapons that will determine our readiness for war if it comes, rather than the number of men [who could be trained]."

"The mechanization which has become so much a part of our daily lives has led us so far from the truth that we have substituted for the actualities of warfare an impossible chimera in which war is reduced to nothing but destruction with all risks taken by machines.

"The idea (I cannot call it, 'thought') has even been advanced that training of soldiers should give way to mass training of scientists to fight our wars for us with test tubes and Bunsen burners."

A Strange Doctrine

All this is just another way of saying, in this time of uneasy peace and undeclared war, that we may rely in battle not upon man but upon the insensate creations of man. Not only is that a strange doctrine from those whose lives have been devoted to teaching men; it leads to a state of mind which precludes the chance of survival in war. That is, the prevailing hopeful reliance on defense.

It is profitless to think of staking our security on defense because, in the end, there is no such thing. The inevitable outcome of successful defense is stalemate, and from this stalemate there is no escape except through the imaginative application of weapons and tactics on the battlefield. This, in turn, must proceed from the staunch moral virtues of the nation itself.

Like Colonel Marshall, "the more I have studied war, the more I have become convinced that its mainstream is the knowledge of moral forces." And the difference between the defensive and the offensive in war is not a matter of weapons or numbers of men; it is a matter of convictions and attitudes.

Offensive Prevails

Even after repeated reversion to the tactical defensive, the offensive-minded army ultimately imposes its will. For the weapon which is effective in defense is also effective on offense, and the adequately trained soldier fights equally well in either case, as long as he is morally prepared to fight at all.

Nothing, perhaps, illustrates this concept better than a comparison of methods and results between World Wars I and II. In the first conflict, four long years in the trenches, marked by excessively bloody and futile linear attacks against fortifications, led to no result except slaughter and frustration. In the end, the war was won by the Allies with the same weapons with which it had been commenced. New tactics, not new weapons, won World War I.

Tank Sole New Weapon

The tank was the sole new weapon introduced during that conflict, but its true potentialities were never exploited on the battlefield. Aircraft were vastly improved during the war, but suffered the same fate as the tank. In the case of both, mechanical frailty and lack of adequate signal communications combined with a deplorable shortage of imagination to limit their effectiveness in combat.

In the end, dispersion of troops in great depth over the battlefield, where they were able to move and to support their movement with fire, took the war out of the trenches. But the underlying change, without which the defensive stalemate never could have been broken, was one of the spirit. Once more the moral factor had proved itself as ten to one over the material.

A quarter of a century later the validity of this lesson was reaffirmed. Although the weapons of World War II were essentially the same as those of the first war, they were never permitted to determine their own application. They were, as weapons by right should be, the instruments of tactics and not its masters. The result was not the bloody stalemate of World War I but a series of richly productive encounters, in most instances at a cost proportionately less in battlefield casualties as far as ground combat was concerned.

It is true, of course, that American industrial potential is this Nation's outstanding physical asset in war. But that is only because it is firepower which counts on the battlefield—not manpower alone—and in that our superior ability to produce superior weapons asserts its true value.

Weapons and Trained Men

In the hands of men trained to use them and convinced of their own invincibility, these weapons can spell the difference between two men and one man on the battlefield. Alone, weapons are but so many masses of metal, and all the weapons America could produce would not of themselves tip the scales of battle one hairbreadth.

America's military weakness is not in weapons or in machines. It is, as always, in America's reluctance to train men to master the weapons it can produce in such profusion. It is in America's persistent tendency to discount the rôle of man in warfare and to send men into the bloody trial of battle unprepared to make the most of the fine weapons it places in their hands.

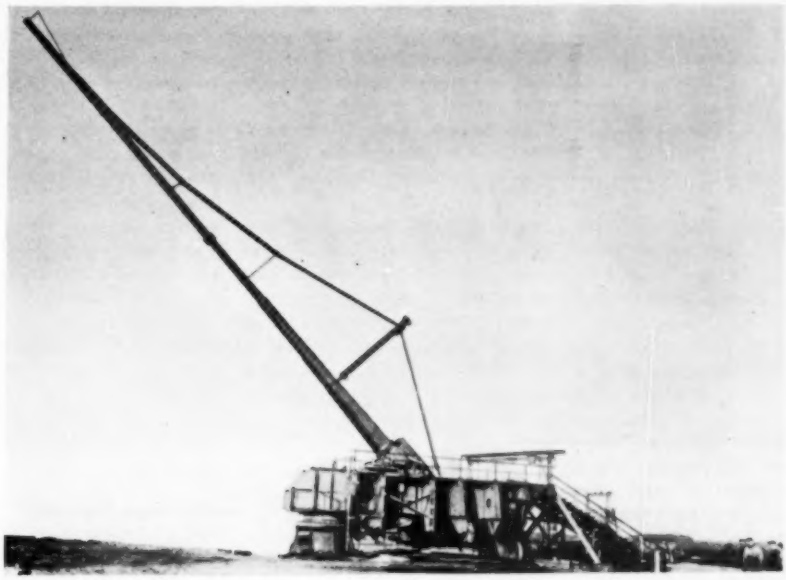
Yet if Americans continue to assure themselves that machines and not men count for everything, there will be no end to this costly process of error.

We Must Be Strong

No doubt it is important to make ourselves stronger where we already are strong. But it is even more important to make ourselves strong where we are weak, for there is no remedy for weakness except in strength.

This Nation must continue to make the best weapons in the world. But while it makes them, it must also train soldiers to use them—soldiers who will be, by virtue of their better weapons and training, capable of meeting any enemy anywhere on more than equal terms.

That Fabulous 1918 Paris Gun Again



Photos Reveal New Details of Famous Long-Range Weapon

G. B. Jarrett

RECENTLY some old German files revealed a pair of profoundly interesting photographs, neither with benefit of caption or the slightest identification whatever. As a collector of interesting old military photographs (especially when they deal with ordnance) the writer was instantly attracted to them.

Without a shadow of a doubt these photographs reveal an original installation and a test firing of the Paris Gun. Of course they were taken at Meppen in East Prussia, where in 1918 the Germans maintained their main proving ground for all artillery weapons.

There can be no doubt of the identification of this weapon. There never was a similar gun-tube, and its construction is identical with the weapon which later became famous as "the Paris Gun." The mount is a typical proof facility, and in several forms similar to this was seen by many Allied ordnance officers following World War II when they were examining various proof establishments throughout Germany. Such a design provides stability for a firing program, together with such deflections as might be required.

One photograph reveals the former German Imperial standard at the masthead. There can be little question that this is one of the earlier Paris Gun test programs—very likely in 1917 when the Germans proofed this gun before aiming it at Paris in 1918, from which operation it eventually derived its name. The Paris Gun became almost a myth, although during the later days of the First World War the bombardment of Paris was recognized as such and not as some sort of aërial raiding, as first proclaimed.

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Today the story is well known among Ordnance personnel, although many less informed people erroneously refer to this great weapon as the "Big Bertha." The gun which fired on Paris is rightfully known only as the Paris Gun, while the Big Bertha refers to a 42-cm. mortar developed by the Germans before the opening of World War I and with which they intended to level (and did) the French and Belgian forts along the frontiers.

Stratospheric Flight

The German physicist, Dr. Rauschenberger, developed a theory that if he were able to fire a projectile into the stratosphere, taking the minimum time required, he would have imparted to it the terrific speed necessary for it to attain very long range without the great frictional loss encountered in the air near the earth's surface. It was recognized at the same time that to

attain such a velocity an extraordinarily long tube had to be provided to afford the sustained push necessary for the shell. A huge chamber capacity would also be needed and all this undoubtedly at the price of fantastic erosion of the tube. Further, such a weapon would have to be excessively heavy, or it could not attain any accuracy at the desired range.

The Big Bertha

The Big Bertha, or 42-cm. mortar, had been built long before World War I on the principle of stratospheric flight, but it fired an almost one-ton projectile some twelve miles high, for a lateral distance of only eleven miles. It was a very heavy and effective shell, but its range was far too short. The new idea (for the long-range gun) emphasized far greater range, and of course the projectile would have to be lighter and many times faster. The fine details have been adequately covered by Col. H. W. Miller in ARMY ORDNANCE ("The German Long-Range Gun," Part I, September-October, 1923; Part II, November-December, 1923; "Behind the Paris Gun," July-August, 1935), and in his book "The Paris Gun," published in 1930. It is not necessary to go into these details at this time, but, as history shows, a few very interesting results came from this Paris Gun.

In 1918 the Germans sought to panic the Parisians into fleeing their city. In this they failed, for the people of Paris took the curse of the long-range bombardment in their stride, didn't flee their city, and worked harder—shrugging off the matter with their inimitable and nonchalant "C'est la guerre."

Small Pay Load

Actually the projectile, to withstand the abuse of its heat-generating travel through the 120-foot tube, was designed with a very small pay load of bursting charge, so that in the final analysis it did relatively little damage as compared with normal 8-inch artillery shells.

The excessively heavy carriage necessitated extensive setup work and a vast amount of camouflage protection, together with many surrounding batteries to offset the enemy sound-ranging devices, etc., in order to survive in any prepared position. Further, it could be easily discovered by reconnaissance aircraft. The cost of producing such weapons was and is great. Even Ludendorff emphatically said in his memoirs that more field batteries, instead of the great expense of long-range guns, would have served him better.

However, the Germans did achieve a few fine results in their development work, and their basic research had been sound. They achieved two important things—great range and a mount that was capable of 360-degree traverse. Though set back temporarily by their defeat in 1918, the Germans continued their studies on great-range problems. By World War II they had worked the valuable findings of their famous and almost forgotten Paris Gun into modern matériel.

By 1936-1938 a new series of ordinary corps and army artillery field mounts possessed the feature of 360-degree traverse, born in the Paris Gun. In a war of rapid movement such a feature could be, and often was, of great value to an army commander. The projectiles fired by these new weapons were quite like the earlier Paris Gun designs in shape, except that they were not prerifled, and all had much greater pay loads in bursting charges.

Railway Guns

Not wishing to give up the tantalizing desire for really long artillery ranges, the German ordnance engineers during the intervening years had worked on this, too, and once more decided upon the use of railway emplacements. Of course this committed them to some very heavy mounts, and the usual necessity for lengthy setup periods.

In a measure they got around this by building turntables on top of the sidings and by countless labor-saving devices to handle the excessively heavy loads. Eight-, nine-, eleven-, and twelve-inch projectiles were developed, along with the guns to shoot them. There was even an 82-cm. gun (31½ inches) which fired a 12,000-pound projectile on Stalingrad. One of these, employing a most unconventional projectile and known as "The Glatt," did achieve a 75-mile range, although its bursting load was far less than that used in the projectile of the original Paris Gun of 1918.

It is interesting to note that all these weapons were intended to be fired at approximately 55 degrees' elevation, and all their projectiles considerably exceeded a velocity of 3,000 feet a second. The "Robert and Leopold," or 28-cm. K 5 (E), better known to our Fifth Army as "Anzio Annie" or the "Anzio Express," was in this famous family of descendants of the original Paris Gun, and the Number 5 projectile was prerifled.

All-Around Traverse

Perhaps the greatest single factor worth remembering is the 360-degree-traverse of the original Paris Gun, which today is found in many modern ordnance designs. However, the excessively long range gun which must be mounted on a railway carriage is as foolish today as it was in 1918, taking far too much time to emplace, being quickly discovered by alert enemy aërial reconnaissance, and being easily destroyed by subsequent bombing raids. Even Goering decried their development at the expense of additional aircraft.

Hidden in Tunnel

Perhaps readers will parry that we had difficulty in locating the "Anzio Express" at Nettuno, but then many do not know, and didn't then, that the Germans hid "Robert and Leopold" in a railway tunnel, a feature made possible by nature, and the only such instance known throughout World War II where nature was so considerate.

From the World War I period to the present day is a long time, but how faithfully some descendants carry on the outstanding characteristics of the parent Paris Gun! What will tomorrow show?

What of Biological Warfare?

Public Health Personnel Form the First Line of Defense

by

Comdr. Frank R. Philbrook

Biological warfare does not destroy buildings and machines but is directed at man himself or his food supply and animals

BIOLOGICAL warfare is essentially public health and preventive medicine in reverse. Except for novel methods of achieving deliberate dissemination of pathogenic microörganisms, it is a form of warfare which nature, over thousands of years, has waged with man and against which our modern health practices have produced effective defenses.

A more precise definition of biological warfare is: "The intentional use of living disease agents, or their toxic products, for the purpose of producing disease or death in man, animals, or crops."

Biological warfare represents another attempt to unleash the forces of nature for use in war. Unlike the atomic bomb or other "blast" weapons, biological warfare is essentially antipersonnel in nature because it does not destroy buildings and machines but is directed at man himself or his food supply, animals, and crops.

This method of warfare is not to be casually dismissed, nor should it strike terror in the minds of civilians or military personnel. Many exaggerated and sensational statements have appeared in the press. As examples, one can mention the widely quoted statement that one ounce of botulinus toxin can kill 200,000,000 people, and the statement that with only one dozen infected eggs enough psittacosis virus can be produced to infect every man, woman, and child on this earth. Many other equally sensational and panic-producing statements could be quoted.

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False Implication

Despite the truth or error of these statements, they often present a false implication requiring correction. The fact remains that such quantities of materials could not be spread thinly enough or disseminated widely enough by an enemy to produce illness or death among more than a very small fraction of such fantastic numbers of individuals.

Obviously it would be unwise from the viewpoint of our national security to discuss in detail the results of our research into the problems of dissemination or to name specific microörganisms which have been found to have characteristics which might enable their intro-

duction, with probable effectiveness, within limited areas.

It can be said, however, that the potentialities of biological warfare are considered great, but in its present stage of development it should not be considered a means of mass destruction comparable to atomic warfare.

In the language of biological warfare the pathogenic microörganisms which might be used are referred to as "agents" or "BW agents." Reference is frequently made to three types: "antihuman agents," "antianimal agents," and "anticrop agents."

Since this presentation concerns public-health aspects, only the defense against antihuman BW agents will be considered, bearing in mind the fact that certain diseases of animals are transmissible to man and that a BW attack directed against man's food supply, if it should prove extremely successful, could result in nutrition problems of public-health interest.

Answers Needed

It is obvious from a civil- and military-defense point of view that answers to the following series of questions are needed for intelligent planning: "What biological warfare agent or agents are apt to be used against us in the event of the employment of this type of warfare?" "Where and how are they apt to be disseminated?" And the "$64 question" is, "What constitutes our defense?"

Some of the answers can be given now, but other and more detailed answers must await the results of further research and development and intelligence on this as yet virtually untried form of warfare.

First let us consider, in a general way, what antihuman biological warfare agents might be used against us. It is impossible to state that any specific pathogen will be the chosen agent, but it may be said that many species, types, or strains would be suitable. Certain organisms have been notorious producers of accidental infections among laboratory workers throughout the world. It would be logical to conclude that these agents would rank high among likely candidates. They fall into the several categories: bacteria, viruses, rickettsia, and even certain fungi.

Laboratory Infections

It is noteworthy that many of the laboratory infections caused by these organisms have resulted from their entry into the body by portals which are not usual in nature. For example, certain viral and rickettsial diseases, which in nature are ordinarily associated with insect vectors, may be contracted in the laboratory as airborne infections when the pathogen is released in the form of an aerosol from a centrifuge or blender. If this can occur by accident in a laboratory, there is considerable likelihood that it can be produced by design in biological warfare.

The attempt could be made to introduce diseases which are already of usual, or endemic, occurrence in the area under attack. Such an outbreak might not be readily recognized as a BW incident, while in the converse situation an unusual or exotic disease might be immediately suspect.

The mere occurrence of unusual disease should not be labeled BW, however, unless there is much other evidence to substantiate such a claim. Nevertheless, epidemiologists should be alert to the possibility of BW implications in certain outbreaks.

Two or more agents might be used simultaneously, thus complicating the problems of clinical and laboratory diagnosis and therapy.

Pathogenic microörganisms vary in their ability to spread from person to person. Many of the potential BW agents which, in nature, may affect man, are seldom passed from man to man directly, but instead reach him through his contacts with lower animals or by insect vectors.

Few Secondary Cases

If such agents were used in actual attack it is probable that only individuals who receive an infective dose during or as a direct result of the attack would be involved in the resultant outbreak of disease.

In other words, there would be few if any secondary cases. Under such circumstances civil-defense problems would be somewhat minimized in terms of the necessity for isolation and quarantine.

Conversely there are potential agents which, in nature, have the characteristic of spreading from person to person (numerous respiratory diseases might be cited as examples). In some instances this spread may be quite direct and rapid and may result in naturally occurring epidemics of considerable magnitude. The capabilities for the artificial production of an epidemic which will rapidly spread from the focus of introduction of such an agent will never be completely known short of actual use in warfare.

Epidemic Uncertain

Many unknown factors are involved in this reverse of public health doctrine, and it is not at all certain that such a spreading epidemic could be set up at will. Even if an agent capable of direct transmission from person to person were used, public health and sanitation measures could tend to limit the outbreak and minimize effects, especially if coupled with adequate therapy consisting of antibiotic and chemotherapeutic medicants—in some instances administered prophylactically.

How would BW agents be disseminated? If biological warfare were initiated, it is entirely probable that it could be launched by one of two methods. One method involves the open use of missiles and munitions, perhaps capable of transport by aircraft, which would probably be designed to set up airborne clouds of BW agents.

Such use would be similar in many respects to chemical warfare, except that the effects would be delayed because of the incubation periods of the several diseases. Indeed, such munitions might be used in conjunction with other conventional blast weapons in order to take advantage of disrupted sanitation and medical services. The aerosols of BW agents produced under such conditions would rapidly disperse into infective clouds which would be

Signal Corps

Biological-warfare agents might be sprayed from aircraft as an aerosol.

odorless, tasteless, and invisible and hence extremely difficult to detect. An important defense is military interception and prevention of the attack.

The second method involves the clandestine introductions of these agents into air, food, or water supplies. The saboteur who sets out to contaminate a water supply would not waste his biological material by disseminating it at the source of a protected supply, because filtration, chlorination, and the other usual sanitation procedures would defeat his purpose. He would more profitably attack the distribution system at a point where chlorine residuals are sufficiently low.

Foodstuffs Vulnerable

Sabotage of food supplies could be successful only when directed at foods which are to be consumed without cooking (such as milk or salads), or cooked foods ready for serving. Therefore cafeterias, bakeries, dairies, kitchens, or possibly soft-drink distribution plants, where food is prepared for mass consumption or consumption by specific individuals, are vulnerable to this form of attack. The attack would thus be primarily directed against the consumers of the specific contaminated items.

Key Personnel

As to when or where an enemy might use biological warfare, the answer is, of course, whenever and wherever it suits his purpose to do so. The possibility of sabotage directed against key individuals or selected population groups in advance of a declaration of war must be borne in mind.

The use of BW agents prior to an open declaration of war could be timed to the anticipated incubation period of disease in such a manner that key individuals might be casualties at a time of need for important action on their part. Attacks against military targets might involve civilian casualties in this as in other forms of warfare.

The greatest return for the least expended effort would be the use of BW in areas where large civilian or military populations are concentrated. The greatest defensive effort must be directed upon these likely target areas and others such as key industrial, communication, and governmental centers.

What constitutes our defense?

Since antihuman biological warfare in certain respects is essentially preventive medicine in reverse, it follows that those in public-health work must form the bulwark of defense against it, just as the plant pathologists, veterinarians, and others in the State and Federal Departments of Agriculture must assume responsibilities for defense against the anticrop and antianimal BW possibilities.

Defense Principles

Every competent epidemiologist, physician, bacteriologist, veterinarian, nurse, or sanitarian who is well informed regarding the communicable diseases has already acquired, by training and experience, the important general information necessary to the formulation of many civil-defense principles. For the purpose of stimulating thought and action by public-health workers who will be concerned with civil defense, a few such principles are presented:

1. Civil defense in the biological-warfare field must be coördinated with defense against other forms of warfare. The over-all plans for hospitalization and other facilities for handling casualties should include provisions for ordinary communicable-disease techniques.

2. Biological-warfare agents produce the usual disease characteristics of the given agent, although the clinical course may be expected to vary somewhat. This variation might be a reflection of an unusually high dosage of infecting organisms, perhaps acquired via an unusual portal of entry, or of the simultaneous occurrence of two or more diseases.

3. Management and control of communicable diseases, including isolation and quarantine procedures, remain the same whether the diseases occur in the natural course of events or are introduced through the use of biological warfare. The measures for prevention of secondary cases and the methods of treatment in current use could be expected to be applicable and thus to minimize the effects of any outbreak due to a BW agent.

The institution of early epidemiological investigations and controls is dependent upon rapid reporting of communicable-disease occurrence. In most localities there is opportunity for marked improvement in reporting systems which would be particularly valuable in the event of biological attack. The development of specialized types of reporting, including those of absenteeism from industry and schools, might be very valuable.

Rapid Diagnosis

4. Preparedness for rapid diagnosis and therapy is important not only for those diseases of usual, or endemic, occurrence but also for those considered exotic or of unlikely occurrence except by artificial dissemination. Such preparedness requires a strengthening of communicable-disease diagnostic laboratories and the establishment of firm liaison with laboratories capable of procedures which may not be available locally, such as those for the diagnosis of viral and rickettsial diseases.

5. Plans for availability of chemotherapeutic and antibiotic substances should be made. The availability of those substances for therapeutic use in cases of communicable diseases is imperative. Their use for mass prophylaxis following a suspected biological-warfare attack might be feasible only under certain circumstances. A recovery and rapid identification of the particular agent used, coupled with the knowledge that the agent is usually susceptible to one or another of these substances, would be important.

"Shotgun prescriptions" of such substances are not recommended, since they might accomplish little and would deplete vital supplies. Their use under such circumstances should parallel their use in naturally occurring outbreaks.

Time Required

Biological detection methods and determinative bacteriology procedures, even for tentative etiological diagnosis, often require time in excess of the incubation period of disease. In most envisaged instances, carefully considered determination to utilize mass prophylaxis methods would have to await the clinical diagnosis of at least the first cases of disease.

6. Immunization might be presumed to afford a measure of specific protection against potential BW agents. However, effective vaccines do not exist for many of these agents, although some vaccines are available and research continues to provide others. Information regarding the particular species, types, or strains which might be used by an enemy might enable the use of a few specific vaccines, but it is considered futile, at this time, to attempt hit-or-miss guesses.

7. Gas masks afford considerable protection and would be of value if an adequate warning of probable biological or chemical attack can be given. Masks for civilian use are under development along with those for military personnel. It is anticipated that they will become available to those civilians who reside or work in or near the most likely targets of overt chemical or biological warfare. Their issuance will probably be dependent upon numerous considerations, among which are their availability and the considered imminence of such attack.

"Since antihuman biological warfare in certain respects is essentially preventive medicine in reverse, it follows that those in public-health work must form the bulwark of defense against it."

Sterilize Water

8. Food and drinking water, if suspected of contamination by biological warfare, may be sufficiently sterilized by adequate cooking or boiling.

9. Public-health authorities must be prepared to cope with the panic which any unusual incidence of disease is apt to cause. Panic is often associated with the unknown. In this respect the educational media of the radio and press can be utilized profitably.

10. The speed of modern transportation, considered together with the incubation period of disease due to potential agents capable of person-to-person spread, is as important a factor in biological warfare as in naturally disseminated disease.

Therefore even the hundreds of communities in this Nation which might be considered ***unlikely*** targets for direct BW attack must be prepared to cope with civil-defense problems associated with the possible indirect effects of attack elsewhere.

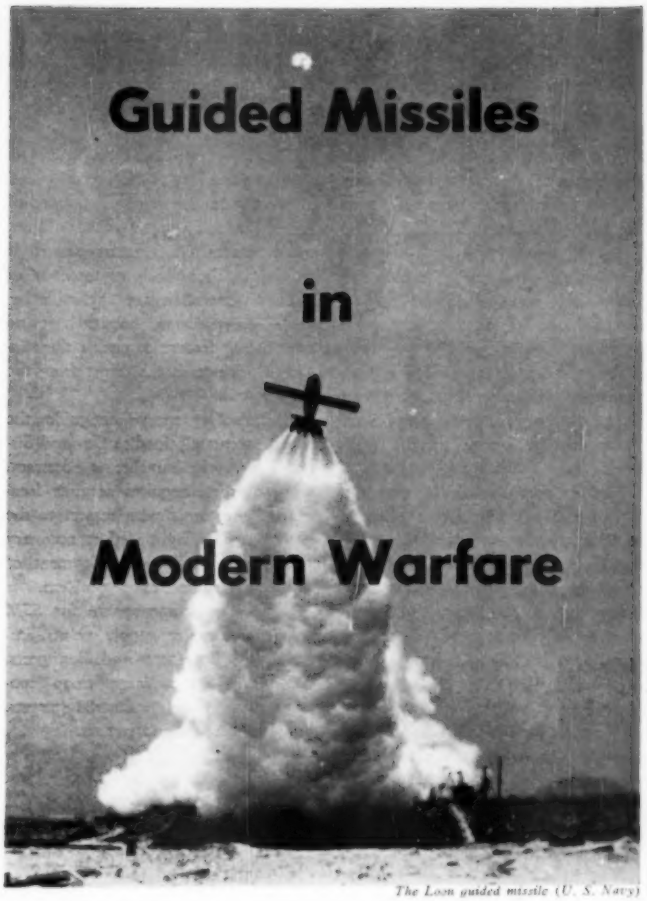
11. Specialized training involving access to the more highly classified biological-warfare information for a few well-qualified epidemiologists and public-health personnel in key State, territorial, or local positions is desirable and contemplated. Such training for defense has already been instituted among key personnel in several Federal agencies. These individuals would make themselves available for assistance and advice in the event of suspected or actual biological-warfare attack.

12. The task of coördinating and planning for a program of civil defense has been charged to the National Security Resources Board. After several conferences between representatives of the Board, the Department of Defense, the Public Health Service, and the Bureau of Animal Industry, a unanimous agreement was reached to downgrade the security classifications of certain aspects of biological-warfare defense in order to release needed information to appropriate State and municipal public-health officials.

Courses Ready

For such persons the Public Health Service has been designated as the appropriate agency to conduct courses of instruction in civil defense against antihuman biological warfare. Courses of instruction have already been prepared and suggested curricula have been presented to the National Security Resources Board for consideration. It is anticipated that arrangements will be completed in the near future and that the information contained in these courses for health-department personnel will thereafter be disseminated to the various agencies and professional associations having a direct interest in this subject.

(This article is based on information given by Commander Philbrook to a meeting of the American Public Health Association in St. Louis, Mo.—THE EDITORS.)



The Loon guided missile (U. S. Navy)

The Potentialities of a New Weapon

Capt. Nels A. Parson, Jr.

WILL military historians ever record the following about the United States?

"Prior to the enemy invasion of Florida the United States Army carefully located its guided-missile units to cover the long vulnerable southern coastline. Ten battalions in all, armed with the new 200-mile-range rockets, were well dispersed and camouflaged and had ample stockpiles of missiles on hand. Missile-launching submarines and aircraft patrolled the seas in search of the invasion fleet.

"When the hostile command committed its task fleet and moved toward the coast, guided-missile fire from submarines, aircraft, and the land-based battalions was initiated at once. Automatic target-seeking devices in the missiles steered the weapons into the enemy ships with a high percentage of direct hits.

"Despite serious losses within the surface fleet the invader established a beachhead south of Jacksonville by the initial use of submarine troop carriers and airborne troops. To counter the devastating guided-missile fire, all available aircraft were dispatched to obliterate the launchers.

Captain Parson has made special studies of the tactical use of guided missiles. He is now assigned to the artillery officer advanced course, Fort Sill, Okla.

Landing Continued

"The effort was only partially successful but by constant air patrolling over all possible areas from which guided-missile fire might come, the invaders managed to discourage all but harassing fire at night. The landing forces continued their build-up in the beachhead for several days.

"Then the United States forces unleashed a powerful counteroffensive on the beachhead supported by seven of the guided-missile battalions which had moved within range. On shore targets, twenty-five to fifty tons of high explosive and incendiary warheads were delivered simultaneously in critical areas. Hostile ships attempting to resupply or evacuate the beachhead troops were driven off by aircraft- and submarine-launched guided missiles.

"With their new position untenable, the invasion force held out until nearly fifty per cent of their troops were casualties. At the time of the surrender some 60,000 troops on shore were lost as prisoners of war or casualties, and 44 ships with nearly 10,000 men were lost at sea. The invasion fleet withdrew and the entire operation was canceled."

This hypothetical account of guided-missile employment is not a "Buck Rogers" tale but a realistic picture of what could occur with guided missiles *which exist today.*

What Can They Do?

The meat of the matter to most of us is this: What can guided missiles do and how can we use them?

A guided missile is a robot device that can be directed to a target by commands originating from outside the weapon or by instruments built into it. It is defined by type according to the location of the target and the launcher. For example, a guided missile launched from an aircraft and destined for a ground target is known as an air-to-surface missile. The three other types are surface-to-surface, surface-to-

air, and air-to-air missiles. Let us take a closer look at each of these three types.

Air-to-Surface Missiles (ASM).—The most outstanding limitation of the conventional aircraft bomb is its lack of accuracy when dropped from a high altitude. Extreme accuracy with ordinary bombs can be achieved only by close-in attack of the target. If the target has a well-organized antiaircraft defense, repeated attacks will prove costly—prohibitively so.

The need exists, then, for a bomb that can be released a great distance from the target without sacrificing accuracy. The ASM fills this need.

Three Basic Types

There are three basic types of ASM's. The first is the controlled bomb whose trajectory can be varied slightly for increased accuracy either by a built-in target-seeking device or by radio remote control from the launching aircraft. It has an accuracy advantage but no greater range than conventional bombs.

The second type of ASM is the glide bomb. By the use of wings on the bomb its range can be increased, resulting in less exposure of the launching plane to enemy fire.

The third and ultimate in air-to-surface missiles is the powered version. The missile has its own propulsion system and can fly a considerable distance after being launched. An outstanding World War II example of this type was the air-launched German V-1 missile. More than one hundred and fifty miles from London, the target area, German aircraft released the weapon which then carried its ton of high explosive to the target city under its own power. (Many of these missiles were also launched from ground positions.) The U. S. version of this missile, the Loon, is shown in the illustration on page 403 being launched from the ground at the United States Naval Air Missile Test Center, Point Mugu, Calif. The same missile can also be launched from a submarine.

ASM's are most effective against ships, bridges, trains, and other targets easily distinguished from their backgrounds. This target characteristic permits the use of automatic target-seeking devices. The missiles will probably be used most often in attacks involving a small number of planes against well-defined and well-defended targets.

Surface-to-Surface Missiles (SSM).—As the mobility and speed of warfare are increasing, the need for effective long-range artillery is likewise increasing. The history of artillery shows continuous effort to improve range, accuracy, and lethality of the weapon. Today, range is the most important limitation. Conventional mobile artillery, even with foreseeable improvements, has a maximum effective range of fifteen to twenty miles.

Aircraft partially answer the problem of long-range artillery. The range of aircraft is almost unlimited, and air attacks are highly destructive. But, as has been stated before, aircraft have limited bombing accuracy and are not always available. Weather, enemy aircraft, or a well-defended target may prevent an effective attack when it is needed most.

Moreover, the chief mission of tactical aviation is to achieve and maintain air superiority. Attack of surface targets is secondary to the mission of supremacy in the air.

The rôle of the SSM is to attack surface targets when aircraft or artillery cannot be used or are less desirable due to their inherent drawbacks. It may also be used in conjunction with aircraft or artillery.

There are two categories of SSM's. The first is the rocket, which carries its own fuel and oxidizer, is not limited to the atmosphere, is supersonic, and has a parabolic trajectory. An example of this type is the German V-2.

The other type is a winged missile which carries its own fuel but uses atmospheric oxygen for burning the fuel. The Loon is such a weapon. The atmospheric-jet missile is limited to flight in the atmosphere, is generally slower than the rocket, and is therefore more vulnerable to enemy countermeasures.

"Guided missiles will have a profound influence on air warfare. The air-to-air missile is of more value to the interceptor fighter than to the bomber and will add greatly to the power of air defense."

The range spread of SSM's is tremendous and may ultimately vary from a few thousand yards to thousands of miles. But this weapon is not without disadvantages. Of foremost concern is accuracy. Target-seeking methods of guidance are often not applicable because many surface targets have no outstanding feature to enable the missile to distinguish the target from the background.

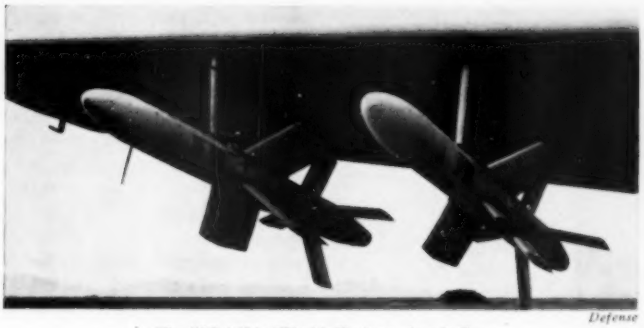
A control system which guides the missile accurately in direction and distance from the launcher is necessary. This, in turn, requires accurate location of the target with respect to the launcher. The logistic effort necessary to support the mass employment of SSM's is likewise a major problem.

Some targets appropriate for SSM attack are: major supply points, important defiles (terrain defiles, ports, beachheads, etc.), large troop concentrations, ships, industrial targets, and major command centers.

Surface to Air

Surface-to-Air Missiles (SAM).—Conventional antiaircraft artillery alone can no longer establish a satisfactory air defense of a vital target. It cannot cope with the high-altitude, speed, and maneuverability of modern bombers. It can, of course, force bombers to fly at such an altitude that their bombing will have excessive dispersion. The ultimate antiaircraft weapon, the surface-to-air missile, hurtles at the high-flying bomber with not only great speed and range but maneuverability as well. As the bomber attempts evasive action the constantly changing predicted point of impact is computed, and the missile alters its course correspondingly to the inevitable destruction of the target.

This does not mean that conventional antiaircraft artillery will become outmoded. The very opposite will probably be true. Targets within effective gun range will probably always be best attacked by guns. For effective defense,



Defense

The U.S.A.F.'s "Firebird" air-to-air missile.

antiaircraft guns, guided missiles, and interceptor aircraft must be coördinated into a single air-defense system.

Each of the three weapons has distinct limitations that one of the others overcomes. Without all three, loopholes will certainly exist.

One can easily visualize the intricate early-warning and target-identification systems that will be necessary in an integrated air defense with guided missiles. It will be characterized by great detection range and almost completely automatic operation.

Air to Air

Air-to-Air Missiles (AAM).—As sonic velocity is approached and exceeded by both bombers and fighters, aërial combat with conventional guns and rockets becomes almost impossible. The high-speed fighter flying at an altitude of 40,000 feet or more not only has an extremely short time of interception with an enemy bomber but doubtless will have no opportunity to make more than one or two passes.

Gone is the former overwhelming advantage in speed and maneuverability of the fighter over the bomber. Modern aircraft also are more rugged than their predecessors and can take a lot of punishment from enemy gunfire.

The air-to-air missile nearly removes the human element. A radar picture shows the pilot the optimum time and direction to launch his missile. Once launched, the robot projectile streaks forward at four or five times the speed of sound, automatically flying an interception course which will make unnecessary more than one pass at that target.

In the light of present development it appears that if a major war occurs within the next ten years guided missiles will have the following effects upon land, sea, and air warfare:

Land Warfare

Land Warfare.—The combat zone will be greatly deepened. Many targets once considered strategic because of their distance behind enemy lines actually will become tactical. Increased dispersion of troops and matériel will be necessary. Massing of troops will have to be done quickly and secretly, followed by rapid dispersal. With SSM support, greater continuity of ground action, regardless of weather conditions, will be possible.

Sea Warfare.—With ship-launched SSM's the Navy will have new offensive power. There is no potential target on the surface of the earth more than 1,700 nautical miles from navigable waters, and a missile of that range will eventually come. Because of the destructiveness of ASM's against surface shipping, the antiaircraft defense problem will be increasingly difficult. The necessity of controlling critical sea lanes will place this problem on a par with the submarine menace. Extensive use of guided missiles in naval operations may result in greater emphasis on offensive undersea craft for all purposes.

Air Warfare.—Guided missiles will have a profound influence on air warfare. The AAM is of more value to the interceptor fighter than to the bomber and will add greatly to the power of air defense. SAM's in quantity will eliminate or greatly curtail sustained mass air attacks.

This development will result in more emphasis on long-range ASM's and strategic SSM's. If SSM's eventually have accuracy exceeding bomber accuracy and are capable of carrying atomic warheads, their employment will become primary rather than secondary.

Human Pilot Needed

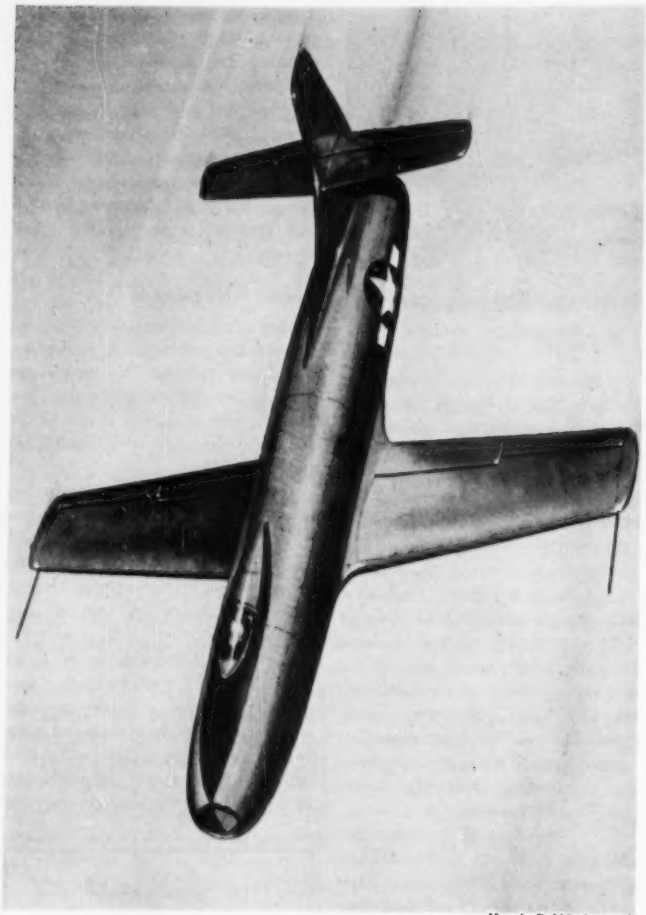
In spite of this, aircraft will always be used for bombing, reconnaissance, and damage analysis. No missile can duplicate the ability of the human pilot to recognize changing circumstances and act accordingly with good judgment.

The strength of guided missiles lies in their joint employment with other weapons. In an over-all sense they will temporarily contribute more to the defense than to the offense, though many years hence the opposite may be true.

The most outstanding limitation of guided missiles is the logistic effort that must be expended to employ them on a large scale. But the ultimate weapons and their future possibilities will justify the cost of development and production in the national guided-missile program.

"The guided missile is a weapon which, like the airplane, carries more explosive farther than the gun. Unlike the airplane it is independent of visibility conditions—it can be used for all-weather operation night or day. Its take-off field is a few feet square. Its fire-control channels can be integrated with the already existing artillery channels, thus bringing the weapon under direct command of the field commander rather than in coöperative effort with him as is the case with aircraft.

"The accuracy of a missile may be made independent of wind and other meteorological variations which do influence the ballistic trajectories of guns."—MAJ. N. M. BENGTSON, *in the November-December 1950 issue of* ORDNANCE.



Navy's D-558 skystreak

Aëroballistics Progress

Navy Symposium Discloses Data Relating To Supersonic Missiles and Projectiles

SIGNIFICANT progress in aëroballistics since World War II, with emphasis on its effect in guided-missile, rocket, and projectile research, has been reported recently by the Navy's Bureau of Ordnance after a symposium sponsored by the Bureau at the Defense Research Laboratory, University of Texas, Austin, Tex.

The papers covered research conducted at the Naval Ordnance Test Station, Inyokern, Calif.; the Naval Ordnance Laboratory, White Oak, Md.; and at universities and industrial organizations engaged in missile research for the Bureau under the technical direction of the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md., and the Massachusetts Institute of Technology, Boston, Mass.

The science of aëroballistics is not new, although the word has not yet appeared in dictionaries. It is actually a combination of aërodynamics and ballistics, both of which treat the motion of objects through the air.

Aërodynamicists, dealing primarily with aircraft, until recently were concerned with velocities up to 300 miles an hour. Ballisticians have been concerned with speeds of 600 miles an hour and above. With the advent of faster modern fighter planes, the widely separated areas of speed that isolated the aërodynamicist from the ballistician have disappeared. This has resulted in an exchange of ideas mutually helpful to both sciences, particularly in that region where velocities exceed the speed of sound and the problems become indistinguishable.

Advancement Noted

A study of the papers presented at the symposium points out the extent to which aëroballistics has progressed as compared with the ballistics of early World War II. For example, Dr. P. P. Wegener of the Naval Ordnance Laboratory described wind-tunnel tests in which the air flow attained a velocity greater than eight times the speed of sound and about three times the projectile velocities obtained in World War II.

This tremendous speed was obtained by causing air at considerable pressure to flow through a rectangular nozzle, scarcely wider than the thickness of several sheets of paper, into an expanding throat.

Dr. Wegener found that the resulting expansion cooled the air to such an extent that the major components, oxygen and nitrogen, tended to liquefy. To overcome this, Dr. Wegener preheated the air to 900 degrees Fahrenheit (above red heat for steel) before the expansion, thus making sure that he would still be working with air and not droplets in the test section.

Unknown Region

The spectacular experiment undertaken by Dr. Wegener explores an unknown region which holds promise of producing essential design information for vastly superior weapons.

Dr. F. K. Hill of the Applied Physics Laboratory presented the results of his

hyperballistic research program which is being conducted in conjunction with Dr. Wegener's studies. This program is in part an attempt to determine the feasibility of using a conical nozzle in a hyperballistic wind tunnel. This type of nozzle offers some very useful advantages from the standpoint of construction, fixed-area ratios, short length, and small angle of flow.

Thorough Survey Needed

It is also evident that in any tunnel operating at ten times the speed of sound the determination of an accurate static pressure will be most difficult and that a thorough survey of the whole expansion section will be required to evaluate any losses in stagnation pressure which may occur.

Air Force

Papers covering investigations being conducted at various Bureau of Ordnance activities in connection with the resistance or drag encountered by fast-flying bodies discussed the three aspects of this problem; namely, compression of the air, friction on the surface, and suction at the base end of the missile.

Dr. L. L. Cronvich of the Applied Physics Laboratory compared theoretical and experimental data relating to the first aspect—compression of the air. Frictional effects were covered by R. E. Wilson of the Defense Research Laboratory, University of Texas. Dr. H. H. Kurzweg, of the Naval Ordnance Laboratory, and N. E. Maxwell, of Consolidated Vultee Aircraft Corporation, discussed the effects of suction at the base end of the missile obtained from systematic tests in wind tunnels, and Dr. M. Finston of the Massachusetts Institute of Technology presented theoretical calculations leading to the estimation of this suction.

Invaluable Data

This discussion of the components entering into the resistance experienced by missiles in flight will furnish invaluable data for the design of faster-flying and longer-range weapons.

Another problem discussed, both from the experimental and theoretical points of view, pertained to the rise in temperature which occurs due to the compression of air. At even the relatively low supersonic speeds achieved to date the increase in temperature may amount to several hundred degrees Fahrenheit near the surface of the missile.

With the prospect of attaining much higher speeds, it will be increasingly important to know the amount by which the temperature rises in order to design missiles which will withstand the forces encountered under these stringent conditions. It is also important to develop measures for the protection of explosives from premature detonation and to locate delicate instruments properly, thus preventing their damage due to overheating.

The experimental aspect of the aërodynamic heating problem was presented by Dr. G. R. Eber of the Naval Ordnance Laboratory. His paper summarized the important conclusions reached as a result of extensive wind-tunnel tests at supersonic velocities up to 4.5 times the speed of sound.

The Heating Problem

Dr. H. Polachek and R. P. Eddy, also of the Naval Ordnance Laboratory, presented theoretical calculations on the heating problem at speeds that cannot be achieved with existing experimental techniques. These speeds are unattainable at present with conventional missiles but are considered possible in the future.

Dr. Polachek and Mr. Eddy pointed out that the complexity of the fundamental equations that had to be solved required the use of numerical methods. The application of these numerical methods were so tedious that some ten years would have been required if only desk calculators had been available.

Calculator Used

Fortunately, the Aiken Relay Calculator (Mark II), a modern high-speed computing machine in use at the Naval Proving Ground, Dahlgren, Va., was available and the computations were performed in a matter of weeks.

The results of these studies indicate the magnitude of the temperature rise at the outer surface and the manner in which the temperature is distributed from the outer to the inner surface for various wall thicknesses. For example, a missile traveling at 10,000 feet a second will have its surface temperature raised several thousand degrees Fahrenheit in a few seconds.

Well Attended

Approximately 275 top-flight scientists from every part of the United States, as well as representatives from England, Australia, and Canada, attended the symposium. In addition to Army, Navy, and Air Force personnel participating in the meetings, the Atomic Energy Commission and universities and aircraft companies engaged in military research sent representatives.

The Latest Jet Fighter Aircraf

The North American YF-93A is a fast, high-altitude penetration fighter—a modified version of the F-86—powered with a J-48 turbojet equipped with afterburner.

The F-86D has the air intake duct for its jet engine under the nose and also is equipped with an afterburner for additional thrust. Its top speed is over 650 m.p.h.

The versatile Republic F-84E can carry two 1,000-pound bombs or thirty-two 5-inch HVAR rockets plus its six cal. .50 machine guns at approximately 600 miles an hour.

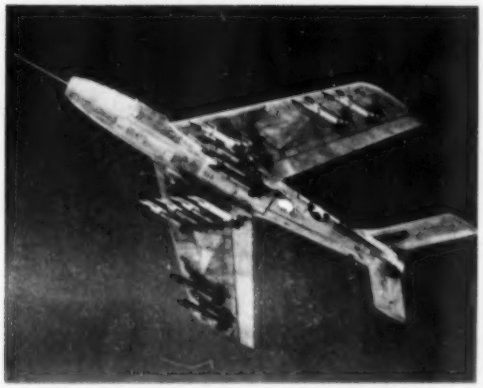
This Consolidated XF-92A is a subsonic-speed, delta-wing research interceptor. "Elevons" on its 60-degree swept-back wing act both as elevators and ailerons.

The wing and tail assembly of the North American F-86 Sabre are swept back 35 degrees, indicating its high speed of 670 m.p.h. It can carry 6 machine guns and 16 rockets.

Powered with an Allison J-33 jet engine of 5,200 pounds' thrust, the Lockheed F-94 has a noseful of electronic instruments which make it an effective night fighter.

of the United States Air Force

The McDonnell XF-88 has wing and tail surfaces swept back 35 degrees. It is a high-speed penetration fighter designed to operate deep within enemy territory.



The Republic F-84F is a swept-wing version of the F-84 Thunderjet. Designed for high speeds and long range, it has extra internal fuel tanks and can carry 24 rockets.

With pressurized and refrigerated cockpit, crew-ejection seats, radar, and 2 Allison J-35 jets, the Northrop F-89 all-weather Scorpion is a fast, versatile fighter plane.

A thinner wing distinguishes the Lockheed F-94C night fighter from the F-94. Also, it is powered by the Pratt & Whitney J-48 jet engine rated at 6,250 pounds' thrust.

Designed as a high-speed, high-altitude penetration fighter, the Lockheed XF-90 has a maximum take-off gross weight of about 30,000 pounds and is powered by 2 J-34 jets.

Powered by a General Electric J-47 jet engine, Curtiss-Wright afterburner, and 4 rocket motors, the Republic XF-91 interceptor has an extremely high rate of climb.

Can it be streamlined?

"DEFENSE BUYING"

Unavoidable Details Make Military Procurement Difficult

by

Maj. Gen. John K. Christmas

Need for competitive bidding and other safeguards unknown to industrial purchasing will normally make a certain amount of "red tape" unavoidably necessary

NATIONAL-DEFENSE procurement or, as ordinary Americans say, "defense buying," is of increasing public interest these days. This is because the Army, Navy, and Air Force are spending more than they have been during the last five years; also because larger and larger segments of industry are becoming involved in doing business with the Government. It is therefore opportune to discuss this very important, although usually "taken-for-granted," subject.

Generally speaking, buying by the Army is almost as different from the purchasing done by a private corporation as Sanskrit is from English. The natural reaction of the businessman is: "Why don't those Army fellows adopt American business methods?"

The People's Will

There is an excellent reason for the difference. The American people for many years have repeatedly expressed their will through the Congress to the effect that they do not want Government buying conducted the way private buying is conducted. This continued collective expression of the will of the American people that is your will and mine and that of the man across the street is probably predicated on two general ideas:

First, the Government purchasing man is not to be trusted as much as the private purchasing agent. (This is mostly an unwarranted assumption, as the percentage of dishonest people in Government is probably substantially the same as it is in private business. The percentage in Government could be less, not because of a necessarily higher moral standard but because the Government chap is easier to catch and to penalize.)

The second and probably the more prominent reason is that every businessman, large or small, good, bad, or indifferent, pays some taxes in support of the Government and feels that he is entitled to a share of the business put out by the Government. This is particularly true when business is "normal"—that is, when we are far enough from prosperity so that practically every businessman is looking for additional business.

It therefore amounts to this: Army buying is not only the operation of filling the Army's needs in the best interest of the Army but partakes in peace and "normal" times of a social and economic endeavor to treat all the citizens equally.

However, the situation is not without hope. There have been great improvements in Government buying methods. First, in February 1948 the Congress passed the Armed Services Procurement Act, otherwise known as Public Law 413, of the Eightieth Congress. This is a very fine piece of legislation governing the buying of the Army, Navy, Air Force, U. S. Coast Guard, and National Advisory Committee for Aëronautics.

General Christmas is chief of the Procurement Division, Department of the Army.

Bill Should Be Read

This new act is not very long and it will very well repay any businessman who is doing or intends to do business with the Government to read it. He should supplement his reading thereof with the Senate report on this bill prepared by Senator Byrd (Senate Report 571, Calendar 597, Eightieth Congress). The report is, in effect, a memorandum explaining the reasons why the committee which drafted this bill recommended it to the Congress as a whole and explains what the committee had in mind in recommending such a bill.

Please note that we have here legal unification in so far as buying by all the armed services is concerned.

Ordinarily an act of Congress such as the Armed Services Procurement Act is a fairly brief piece of legislation, charging certain officers of the Executive Department with the execution thereof. The executors in the case of this act are certain designated officials of the Army, Navy, Air Force, U. S. Coast Guard, and National Advisory Committee for Aëronautics.

Procurement Regulation

In addition, most acts of Congress require for their execution a set of implementing regulations, giving detailed instructions as to how the act will be carried out. This regulation, in the case of the Armed Services Procurement Act, is known as the Armed Services Procurement Regulation. Prior to publication the sections of the regulations were discussed with business and industry through the mechanism of contact with the various major busi-

ness organizations and trade associations.

Not only does this law cover the buying by the Army, Navy, and Air Force, but even the detailed regulation governing the execution of the law is the same in each case. We thus have still further unification in that the same regulation is used by a naval purchasing officer as by an Army or an Air Force purchasing officer.

The Human Element

However, we still have the variable that people are not, and probably cannot, be standardized so that all the way up the line, from the contracting officer at the grass-roots level to the Cabinet officer at the policy level, minor variations are of necessity produced by different human interpretations of policies and instructions.

Furthermore, each departmental "procurement secretary" may, of course, prescribe policies within the purview of the law and the regulation, where liberty is allowed, so as to make the buying habits of one military department differ in minor ways from those of another. Some reference will be made to this later.

The high light of both the law and the regulation governing buying by the National Defense Establishment is that the normal practice will be to purchase by competitive bidding with the use of specifications and sealed competitive bids. The burden of proof is on the department when it wishes to buy otherwise; that is, by negotiation. Here, of course, we have the major difference between our buying and that of private corporations.

Social Benefits

Thirdly, there developed in World War II a school of thought that the Government should distribute its business in such a manner as to effect certain social or economic benefits to the Nation as a whole. For instance, the procurement law directs that "a fair share" of defense business shall be awarded to "small business" (less than 500 employees).

During the minor recession in early 1949 there was developed a "distressed-area" program, the purpose of which is to assist the channeling of Government procurement into areas where there is a high degree of unemployment.

The purchasing agent of a private corporation wishing to buy, let us say, a number of executive-type desks would briefly describe the desk and inquire of a number of firms which he considers reliable as to their prices and deliveries. He might also ask for their literature and see their sales representatives. As a result of all the information available to him he would then decide which combination of desk, price, and delivery would best meet his firm's situation and then place the order with that desk company.

The Government buyer does not have that freedom of action. In the first place, the fact that the Government desires to buy desks must be widely advertised in order that all interested parties will have a chance to bid.

After the bids have been received it is frequently necessary to spend considerable time in studying them in order to determine which bidder is in fact the lowest bidder considering all matters, such as transportation costs. Difficulties may then arise as to mistakes that are alleged to have been made by the bidder in submitting his quotation, and questions may arise as to whether or not certain bids were postmarked before the deadline established in the invitation.

All these matters require time and offer opportunities for meetings, appeals, or even litigation and other delays which the layman generally refers to as "red tape."

Moreover, interested parties must be told exactly what is wanted in the specification. This must fully describe the desk in great detail because among the hundreds of people who may, and probably will, bid on this desk there may be one or two who will offer a desk of an inferior quality unless every last detail is carefully specified. This results, of course, in Government specifications being very long and very detailed.

Free Competition

Secondly, they must be written so broadly as to (a) obtain full and free competition, and (b) not exclude any particular make or process of making a desk. It can even happen that the low bidder on the desk for the Army has never made a desk before and insists on his right to go into the desk business, with the result that he may have difficulty in meeting the specifications.

Should the order for desks be of any magnitude, and particularly if it be with a firm of unknown reputation, it is important that the Government employ an inspector in the contractor's plant to see that the Government gets exactly what is specified and not something different or inferior. Without going into further details it is obvious that in all these steps there lie potentialities for arguments between the vendor and the Government, extra paper work, and potentialities for delay. Of course, these administrative operations add to the cost of the article we buy.

Exceptions

Luckily for the national defense, Public Law 413, referred to above, contains a number of so-called "exceptions" representing conditions under which the Army may buy by negotiation, as do most private buyers, from a selected group of qualified potential producers. These exceptions cover such situations as public exigency, the nature of which is obvious; the purchase of perishable foodstuffs, which is also obvious; and small local purchases of less than $1,000, which covers most of

Army buying is not only the operation of filling the Army's needs in the best interests of national defense but partakes in normal times of a social and economic endeavor to treat all citizens equally

the small purchases made at Army posts by Quartermaster, Engineer, and Signal Corps officers, etc., in maintaining the necessary housekeeping services at the posts where they are responsible.

Since the only excuse for maintaining an Army is to win our country's wars, two of the most important exceptions are ones which allow the Army, if personally approved by the Under Secretary of the Army, to buy by negotiation from firms which have specialized know-how or previous experience or tooling.

These exceptions also make it possible to buy important weapons and other complex equipment from firms which have been allocated to the Army under the Department of Defense Industrial Mobilization Plan or otherwise in the interest of furthering our industrial-preparedness program. This privilege is exceedingly important if we are not to have complete chaos on the outbreak of a major war, because in war we must follow the Industrial Mobilization Plan of the Munitions Board.

Right to Negotiate

However, in such critical conditions as now obtain, an intelligent and limited use of this right to negotiate is of great importance in setting the pattern for the procurement of such major equipment as tanks, range finders, guided missiles, complicated radar equipment, and similar noncommercial items requiring great technical and managerial ability and having a long lead time.

There still remain two important exceptions to consider. One is that which, on the declaration of an emergency by the President or the Congress, allows the Department of the Army to negotiate all its business, or at least to negotiate to the extent desired. This condition now prevails.

The other important exception is one having to do with the standardization of equipment. With respect to machine guns, tanks, and other equipment where the design and specifications are originated by, owned by, or controlled by the Army, we are of course able to obtain the necessary standardization and interchangeability so that the machine guns in one division will be the same as those in another division. However, when we come to commercial articles, we have a different situation.

Prior to the passage of this act, and prior to the Second World War, the Army was in the unhappy condition of owning some 400 different makes and models of trucks. This was due to the fact that these trucks had been bought in small increments in annual competitive procurements against performance specifications. The result, of course, was chaos for the Army with respect to training, maintenance, distribution of spare parts, and similar operations.

"There developed in World War II a school of thought that the Government should distribute its business in such a manner as to effect certain social or economic benefits to the Nation as a whole."

Under one of the exceptions in Public Law 413 this situation need no longer exist if the "procurement secretary" will make a finding that it is in the interest of National Defense that the Army be equipped with a certain type of truck in, say, the 10-ton class, in order that all the 10-ton trucks throughout the Army may be the same and may have interchangeability of parts. This is a great benefit to our combat units in the field.

However the Army has applied this right to standardize equipment only to a very limited extent. It is not applied to ordinary commercial-type "housekeeping trucks" which are used at posts, camps, and stations in the United States for hauling rations, coal, mail, and other supplies. It is not applied to domestic refrigerators, fork-lift trucks, or any other equipment of commercial origin, the use of which is restricted to the continental United States, because dealers and service are readily available and the troops are not dependent on the Army's own supply system.

I think all will agree that this is a wise policy in order to insure not only price but engineering competition among the makers of the thousands of commercial products necessary to maintain an Army.

While the manufacturer of electric refrigerators might be happy to have his make adopted as a standard by the Army for use in its hospitals, camps, and posts, you can imagine the feeling of his competitors who were excluded from obtaining any of this business.

A Critical Period

The present period in our procurement is a most critical one because while we have men fighting and are under certain emergency conditions we are still largely at peace in so far as procurement is concerned. There is no doubt in my mind that it is this situation which has led to criticism of the Army by intelligent people with respect to a number of questions.

We have been charged with not letting industry know what our requirements are and, by implication at least, of not knowing what we do need. Please be assured that we do know what we need and have it well figured out far into the future. However, by law and by the customs of our country our needs are not allowed to be made public even in a general way until our budget has been sent by the President to the Congress.

Laws Fair to All

Further, there is a strict prohibition against making procurement information available to one segment or one firm in industry before it is made available to all others. Here again are cases where you must agree that the laws and regulations are in the interest of strict fairness to all, although at the same time such rules do prevent the forward planning which is essential to a well-run business.

Because the American economy is, in general, prosperous at this time we are not now "besieged" by prospective contractors as we are in more normal times. This situation, of course, varies

from industry to industry and from firm to firm. In certain areas of business having to do with items which are easy to make, our lists of firms desiring invitations to bid are overloaded. There also appears to be a desire on the part of some firms to get defense orders so that they may not be closed down for lack of materials.

Secondly, if a firm fills all or most of its capacity with defense orders it may lose its competitive position with the public and with its dealers. It is the object of the "DO" (or defense-order) rating, and of other orders issued by the National Production Authority under the National Production Act of 1950, to correct this situation both in the interest of the armed forces and in fairness to all.

This is perhaps a significant point at which to bring up something of interest to those of you who may wish to, or are forced to, do business with the Army; that is, that the Army does its buying in a decentralized manner through a large number of field offices strategically located in the metropolitan centers of the United States. These field offices should be your initial point of contact.

Avoid Washington

In at least ninety-nine out of a hundred cases there is nothing to be gained by coming to Washington. This mechanism of Army buying is described in greater detail in a pamphlet published by the Department of the Army for the information of potential vendors to the United States Army. A copy of "How To Sell to the United States Army" may be obtained by writing to the Central Military Procurement Information Office, 3D-760, the Pentagon, Washington 25, D. C.

There is another significant development which is not widely enough known and which is primarily an outgrowth of unification of the armed services, and that is the institution of "single-service" procurement. This covers a large portion of the money value of what we buy. For example, all automotive equipment, including armored fighting vehicles such as tanks, is bought by the Ordnance Corps of the Army, regardless of whether it is for the Navy or the Air Force or for the Army itself.

Similarly, the Quartermaster Corps of the Army procures, with a few minor exceptions required by the exigencies of the service, all the food used by the Army, Navy, and Air Force. Likewise the Navy buys all solid fuels and the Air Force all photographic material. This subject also is fully described in the pamphlet referred to above and is worthy of study by people doing or intending to do business with the Army.

There is one point that I think will be of general interest because so many of my acquaintances in business seem to have been misled with respect to the volume of the Army's procurement. When you see in your local newspaper that the Congress has appropriated, for example, fourteen billion dollars for national defense, and if, on reading, you find that the Army has been given roughly one-third of that, do not jump to the conclusion that all the money is going into trucks, fighting tanks, refrigerators, compressors, and tires, because it isn't.

"Luckily for the national defense, Public Law 413 contains a number of so-called 'exceptions' representing conditions under which the Army may buy by negotiation, as do most private buyers, from a selected group of qualified potential producers."

A major part of our funds goes into the pay roll, feeding and housing of our military personnel, and the pay roll of the very necessary Civil Service personnel who support the military personnel in offices, depots, arsenals, laboratories, and similar activities.

Procurement Funds Minor

It is therefore obvious that only a minor part of our funds is used for procurement. For example, the Army's *total procurement* for all purposes (including things which we bought for the Navy, the Air Force, and things we bought for foreign aid and for assistance to the occupied countries) totaled in the fiscal year 1950, which ended last June, 1.9 billion dollars.

The one misunderstanding which I would like to clear up is the supposedly large procurement now going on because of the war in Korea and other aspects of the international situation.

Do not be misled by discussions in the press or over the radio of fifty-, sixty-, or seventy-billion-dollar budgets. You will find by examination of the Congressional Record that no such amounts have been appropriated for the armed forces.

You can, of course, make your own guess as to whether budgets of that size will be appropriated, but I can assure you that no Government contracting officer is in a position to make contracts out of these fictional figures for the very good reason that it is a felony to expend money not yet appropriated by the Congress.

Buying Rate Increased

It is true that our *rate* of buying has increased since the outbreak of the war in Korea because of the faster rate of obligation of our regular fiscal year 1951 appropriations and also because of a supplementary appropriation for the Department of Defense totaling about 10.5 billion dollars. Between July 1 and November 1, 1950, the army had legally obligated (not expended or paid out) approximately 1.6 billion dollars.

This is hardly a rate of buying to upset our economy or cause, at least now, such shortages of material as we hear and read about. It does represent an increase in our rate of buying of about 400 per cent, and it proves the flexibility and readiness of the Army buying system to meet emergencies.

In closing this discussion of the very important and very extensive subject of Army procurement I ask you a favor. If you have not done business with the Army before, make it the duty of some one in your organization to become familiar with the multitudinous regulations governing Army procurement in order that you may not be misled—remember that Army buying is different from private buying.

6,000 jobs a month

Ordnance Maintenance in Korea

The 27th Ordnance Company "Retrieves, Repairs, Returns"

1st Lieut. Charles A. Rogers

SUBFREEZING temperatures and war-bred supply problems are but one facet of the 27th Ordnance Company's bare-fisted brawl to keep front-line troopers in Korea equipped with material ranging from sensitive wrist watches to artillery guns and Patton tanks.

Full Production Schedule

Though only a single Army company in size, this outfit of the 1st Cavalry Division has been delegated the task of retrieving, rebuilding, or repairing all damaged divisional ordnance equipment. And that overwhelming task has evolved into a full-dress production schedule involving more than 6,000 separate repair jobs a month.

In September 1950 the company serviced and returned to 1st Cavalry fighting echelons 4,600 small arms, 200 artillery guns of various sizes, 500 conventional motor vehicles, and 40 light and medium tanks. The proverbial "Three R's" have been revised by the 27th Ordnance Company to mean: "Retrieve, Repair, and Return."

Routine among the 27th Ordnance's multitude of labors is the recovery and repair of a tank damaged in fighting or transit across treacherously narrow Korean roads. More often than not, the gears of recovery-repair are set in motion by a telephone call from the front, pin-pointing the tank's location.

Tank Recovery

Swinging into action with a huge, crane-fitted, tanklike tracked vehicle and a flat-bed trailer, the company's 5-man recovery team embarks to the stricken tank's site. Well-oiled weapons are kept close at hand by the recovery craftsmen, a precaution against intruders in the enemy-infested territory in which the tank usually lies. A wary eye is kept on every inch of the tank during recovery, too, since the enemy has been known to booby-trap damaged American equipment cunningly.

With their cumbersome, powerless burden loaded on the trailer, the team of retrievers returns to the 27th Ordnance's work area and begins the tedious servicing task.

A work leader and two assistants, specialists in tank repair, take over from there and stay on the project until the armored monster is fully serviced and ready for return to combat. Often, however, supply snarls make necessary parts unavailable, and time is lost on the job. But a section of toolists—craftsmen personified—conceive, design, and hand-tool parts on the spot. Working under such coöperative conditions, an average tank-repair crew completes work and returns the tank to the ready line in eight hours.

Symbolic American ingenuity hasn't overlooked the 27th Ordnance. Most painstaking and consistently tedious task with which it was confronted in the pioneering days of the Korean war was the decosmolining of thousands of rifles weatherproofed with tenaciously gooey grease.

Working by the hand method with brush and gasoline, it took an experienced Ordnanceman two hours to free the weapon from its cohesive protection. But then 27th Ordnance's Sgt. John Waites of Columbus, Ga., devised a better method, considered to be an outstanding field expedient.

Lieutenant Rogers is attached to Headquarters, 1st Cavalry Division, somewhere in Korea.

Said Sergeant Waites: "We cut a 55-gallon steel barrel in half, filled it with a mixture of oil and water and heated it until it nearly boiled. Then we took the cosmolined weapons and dipped them in the mixture for two minutes. When we pulled them out, all the cosmoline had melted away, and all that was left on the rifles was a light coat of oil—just the way we wanted them." Today, a 27th Ordnanceman can mass-clean five sorely needed rifles in two minutes.

Handmade Tools

Field expedients, however, haven't been confined in the 27th Ordnance Company to weapons-cleaning alone. Meeting the mammoth demands of operations under combat conditions, nearly all tools and equipment used in tank work have been handmade by the company. The greatest amount of hand-tooled work has been on special wrenches and motor slings for various makes of tank engines not in use by the 1st Cavalry Division before or during the early stages of the war.

A bitterly cold Korea, with mercury readings deeper than a dry well, has given rise to other problems. All major repair tasks must be done out in the open, and the mechanics find it impossible to do intricate work while wearing gloves. As one mechanic put it, "When you reach for a tool, it's just like picking up an icicle. You have to look to be sure what you're holding."

"Doing Our Best"

It must have been these men of whom Capt. Charles J. Bliss, 27th Ordnance Company, said: "Korea is loaded with anonymous soldiers who are struggling under adverse conditions to win this war. We're only a small outfit, but we're doing our best."

Substituting Speed for Men

Faster Supply Will Decrease the Need for Service Troops

Lieut. Col. Page H. Slaughter

YOU can usually start a bang-up argument between military men by merely mentioning the fact that we have too many service troops in the Army. You can start a better argument by stating that we need even more. Most tacticians are convinced that we have too many, most logisticians that we have too few. By looking at our past performance and at the shape of things to come—and depending upon which side you want to take—you can convince yourself that either, or both, views are correct.

40,000 Troops per Division

In the last war we maintained about 40,000 troops for each combat division in the oversea theaters of operation. The average combat division contained 17,000 troops. Thus we see that only forty-two per cent of our troops in the theater were in combat divisions, and of this number about ten per cent could be classed as service support troops. Considering the necessary combat support troops behind each division in corps and army rear areas, we come up with the conclusion that at least forty-three per cent of our troops in the theater were service troops.

It is hard to convince a combat soldier that our logisticians are efficient when we require four noncombat men in the rear to support six combat men in the fight. On the other hand, looking to the future the logistician sees as a nightmare picture the snowballing requirements for more and more service troops.

Colonel Slaughter is an instructor at the Command and General Staff College, Fort Leavenworth, Kans. The views here expressed are those of the author and not necessarily those of the Department of the Army, the National War College, or the Command and General Staff College.

Equipment More Complicated

We are developing more—and more complicated—equipment. We feel that we need this additional equipment to offset our disadvantage in numbers of combat troops compared with our most obvious potential enemy. If we have more equipment, and that more complicated, it appears that we will need more men to move, store, distribute, service, and maintain it. We will need more supplies to support these addi-

tional men, more transportation to move these additional supplies, and more men to operate the additional transportation.

If we disperse our matériel to protect it from atomic destruction, we need larger stocks in the theater—and again more men to handle these larger stocks. It will take more service troops to "service" these additional service troops—*ad infinitum*.

Where Will It End?

To increase the combat power of our limited number of combat troops by adding equipment, we must produce increasing numbers of service troops, in turn further reducing the number of troops available for combat. To what ratio will our four "servers" to every six "fighters" grow if we keep on increasing the tonnages of supplies and equipment we must handle?

We need more equipment, which requires more service troops, and we need more fighting troops at the same time. The manpower potential for the Army is limited. Something *has* to give. Instead of trying to change the problem we have to face it and bend our efforts toward an optimum solution. It seems to me that the tactician and the logistician can get their heads together and do just that.

The tactician is principally interested in securing and properly using sufficient combat manpower, supplies, and equipment to destroy the enemy. Agreed that we will furnish him the best supplies and equipment we can produce, he still needs a lot of men with rifles. What can he do to free some of those communications-zone carton-counters to carry rifles for him? He can make two principal efforts that will bring results.

Reduce Equipment

The first is to reduce the number of items of equipment (and consequently the tonnage) he requires to fight his battles. Do we actually need our vast variety of similar items of clothing, equipment, vehicles, and armament to accomplish our combat mission? Do we have to have a ration with over two hundred items in it? It seems only logical that the situation can be studied realistically and that we can make reasonable reductions in the number of items we need without sacrificing morale, combat efficiency, or our ability to slug the enemy to a halt.

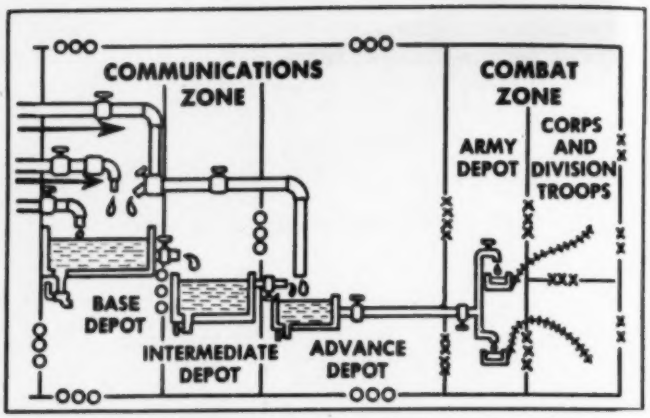


Diagram showing flow of supplies from communications zone to combat zone.

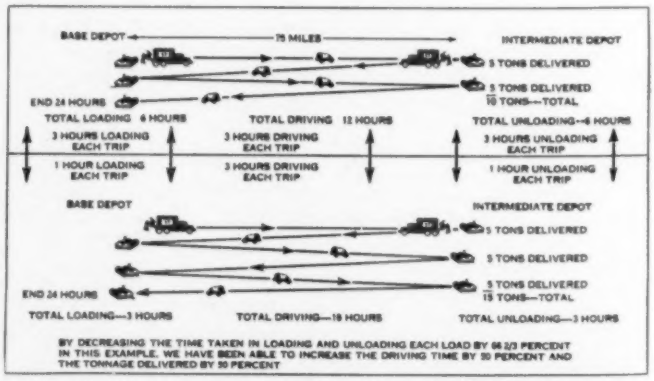
Standardization and reduction of the number of items immediately reduces the original tonnage required as well as the replacement and repair items and the spare parts needed, together with the number of men necessary to handle them.

The Tactician Can Help

The tactician, too, can become more efficient in the use of the items supplied him. We need a greater realization of responsibility for property in the combat zone. Greater emphasis and training on care and maintenance—supply economy—will obviously reduce the number of items and the tonnage we must handle to give the tactician the amount of equipment he has the right to expect.

The second effort the tactician can make is to reduce the amount of service now required for his combat troops. Admitted that we like to fight a gentlemanly, comfortable war, could we not still do without some of the creature comforts we carry along with us? Can't we live off the land, in some part at least? Must we really have mobile bakery companies to provide fresh bread at the rate of a half pound per man per day?

Can we get along without mobile clothing-exchange and bath companies, mobile sales companies, special service companies, unit bands? True, some of these services may be desirable, or even necessary, but can't we improvise or use facilities already in the theater?


BASE DEPOT
75 MILES
INTERMEDIATE DEPOT
5 TONS DELIVERED
5 TONS DELIVERED
10 TONS—TOTAL
END 24 HOURS
TOTAL LOADING 6 HOURS
TOTAL DRIVING 12 HOURS
TOTAL UNLOADING—6 HOURS
3 HOURS LOADING EACH TRIP
3 HOURS DRIVING EACH TRIP
3 HOURS UNLOADING EACH TRIP
1 HOUR LOADING EACH TRIP
3 HOURS DRIVING EACH TRIP
1 HOUR UNLOADING EACH TRIP
BASE DEPOT
INTERMEDIATE DEPOT
5 TONS DELIVERED
5 TONS DELIVERED
5 TONS DELIVERED
15 TONS—TOTAL
END 24 HOURS
TOTAL LOADING—3 HOURS
TOTAL DRIVING—18 HOURS
TOTAL UNLOADING—3 HOURS
BY DECREASING THE TIME TAKEN IN LOADING AND UNLOADING EACH LOAD BY 66 2/3 PERCENT IN THIS EXAMPLE, WE HAVE BEEN ABLE TO INCREASE THE DRIVING TIME BY 33 PERCENT AND THE TONNAGE DELIVERED BY 50 PERCENT

Theoretical truck turnaround in twenty-four hours, showing increased tonnage.

In summary, let's say that the tactician will be contributing his part if he reduces his requirements and takes better care of what he has.

With the help of the tactician, the logistician can greatly reduce the amount of supplies and equipment he is forced to handle, but this admittedly will be a small percentage of the reduction that must be achieved. To do his part, then, it appears that the logistician must further drastically reduce the tonnages he handles to meet the tactician's *minimum* requirements.

The logistician's sole excuse for being is to support the combat zone, and one of the effective means of support he can render is to make additional men available for fighting. To make this contribution he must determine ways and means of reducing his manpower requirements by restudying what he is handling, why he is handling it, and how he can handle it with fewer men.

Let's look back for a few moments to the tonnages we handled and consumed in Europe in the Second World War. From D-Day to VE-Day we discharged on the Continent an average of 74.1 pounds per man per day. A total of 16,177,872 long tons were discharged (and rehandled) on the Continent in this 11-month period. Actual consumption figures for this entire time are almost impossible to find and, due to the varied types of action at different times, probably would not accurately reflect our actual needs.

However, the 2-month period from February 24 to April 25, 1945, included the crossing of the Roer River, the build-up for and crossing of the Rhine, and the subsequent advance to the Elbe. Consumption figures for this period *are* available and should reflect our needs at the time of our most extensive movement and effort. The average consumption for the troops of the five field armies comprising the Twelfth and Sixth Army Groups was 39.1 pounds per man per day.

Shipped More Than Used

The above statistics cannot be accepted as proving without question that we discharged and rehandled almost twice the tonnage we actually required. However during the month of May 1945 we still discharged at continental ports 184,000 long tons *more than we were able to move from the ports,* and moved into depots 207,895 long tons of rations and ammunition *more than we issued from depots.*

In June 1945, after the fighting was over, we were still moving 160,000 long tons a day to meet troop requirements of 20,000 long tons a day, and there were 1,250,000 long tons of ammunition on the Continent and 1,000,000 long tons of miscellaneous supplies still in Great Britain.

"Our primary concern is delivering supplies to the consumer when he needs them. Where these supplies are stored is unimportant if we make deliveries on time. By speeding up our transportation we can keep a larger bulk of our supplies at greater distances from the combat zone and still deliver them when needed in the same length of time we now require."

Without drawing any definite mathematical conclusions from the above figures, we can still readily admit that the logisticians in World War II in Europe hauled, stocked, distributed, and serviced vast quantities of supplies and equipment that were not actually needed or used.

Why did our logisticians in the last war move tonnages so much in excess of our actual combat demands? Innumerable reasons can be advanced. One answer is that our planning figures for requirements were not too accurate. Another is that we included too great a safety factor in the event our transportation system was disrupted or broke down.

We operated on the principle of plenty of everything for everybody—plus a good padding in case things went wrong. Our supply system operated on the principle of the shotgun rather than the rifle. If you shoot enough pellets you are bound to hit every one, but with better aim we could have hit every target with fewer bullets.

Another big reason is that the bulk of our supplies were not where they were being used. That is to say they were too long in transit, too long in storage, too long in distribution. In essence we fill our pipeline with supplies at one end, and they flow out the other end to the user. But we had too slow a flow in the pipeline. The slower the flow the more supplies required to keep the pipeline full, the more men we need to man the pipeline, and the more supplies we have left over when we stop tapping off at the far end. These are only a few of the many reasons why we were forced to handle so much more than we actually used.

What Can We Do?

Returning to our basic problem of reducing the number of service troops required to render adequate logistical support to our combat forces in the theater—what can we do about it? There are many things that can be done. We can increase our logistical productivity by being more efficient in all our operations.

Better training and leadership in our logistical troop units will help. Better planning will help. Accepting a calculated risk and drastically reducing our safety factor of padding will help. And, finally, I feel that substituting speed for men will help.

The most obvious place in which we can effect a speed-up of our logistical support is in the pipeline from the zone of interior to the combat units. We can accomplish this speed-up by three principal efforts. First, by simplifying and speeding up our communications and requisitioning procedures; secondly, by restudying and simplifying our distribution system; and, thirdly, by speeding up our transportation.

Expert Study Needed

Each one of these efforts will require a great deal of study by experts, and accomplishing an acceptable goal will be difficult. Consideration of some of the steps we might take is of value and may stimulate some further thinking that will bring tangible results.

"Administrative difficulties" account for the fact that an oversea theater cannot requisition on the zone of interior on an essentially retail rather than wholesale basis. Generally speak-

ing, we requisition once a month for thirty days' worth of what we think we are going to need—enough to last us until we send in our next requisition. Our "order and shipping time" from forwarding of requisition to receipt of supplies is such that we have to requisition for delivery 90 to 120 days in the future.

Surplus for Safety

Then, of course, we have to have a safety pad of supplies in the event something happens to that shipment enroute. We must have enough to take care of our combat customer until the shipment can be replaced. The size of the pad is determined, in large part, by the length of time it takes to get the replacement to the user—a minimum of sixty days of supply being considered quite normal. If we could make our theater requisitions every ten days instead of every thirty we could more closely estimate our actual requirements, there would be less supplies in each shipment, the safety pad could be reduced, and we would need fewer service troops.

At present we allow fifty-five days from receipt of requisitions in the zone of interior to arrival of the supplies at zone of interior port for oversea shipment. Sears Roebuck & Company daily receives 250,000 individual mail orders, averaging 3½ items per order, and has every one of them assembled, checked, accounted for, and shipped within 24 hours of receipt of the order. If we were only one-tenth as fast with our paper work as Sears we would have our supplies moving to ports in ten days instead of about forty.

Bulk handling of supplies consumed at a fairly even rate is obviously more economical than any special order system, and we should make provisions for an automatic flow of such items in the *minimum* quantity needed, with requirements above the minimum secured by rapid handling of requisitions. In brief, we can produce a considerable speed-up in our supply system by improving our business methods.

We have considered how to get supplies started faster. Our next problem is how to get them to destination faster. Faster transportation alone is not the answer. The biggest saving can be made in reducing the time that the supplies are not moving at all.

Disregarding any handling from manufacturer to zone-of-interior depot, we moved supplies in World War II from depot to port, *transferred* to ship, moved to overseas port, *transferred* to land transport, moved to base depot, *transferred* (sometimes moved to intermediate depot, *transferred*), moved to advance depot, *transferred*, moved to army depot, *transferred*, moved to army supply point, *transferred*, and finally moved to unit distribution point and the troops.

What we need is a distribution system that requires less handling en route. We need not only to reduce the number of tons we handle but the number of times each ton is handled. Air transport is one obvious answer, for it eliminates many of the transfers involved in other means of shipping. Agreed that we must transfer from land to water to land transport for our routine bulk supplies, cannot we devise a system which delivers these supplies more directly from oversea port to consumer?

With such a system we could do the bulk of our warehousing and paperwork in the zone of interior, where personnel living at home are available, and correspondingly reduce our service-troop requirements overseas. Reducing the time our supplies are being stored and warehoused reduces the tonnage required to keep the pipeline full and will further reduce our service-troop requirements.

To attempt to set up a system of supply from the zone of interior with an absolute minimum of handling in the theater we must have fast, reliable, routine transportation and an even faster, more reliable system of emergency transportation. If the logistician could convince himself, as well as the tactician, that he could expect on-time deliveries of supplies where needed, he would not be interested in the extra supplies and extra handlings presently required to insure uninterrupted flow to users.

Speeding up our transportation produces economies in more ways than one. First of all we need fewer transportation units—ships, trucks, planes, railway cars—if they move faster. Generally speaking, if these units move twice as fast we need half as many units to move essentially the same tonnage. Secondly, if the units move twice as fast, we will need only half as many supplies in transit at any one time to keep the pipeline full.

Doubling the speed of transportation units while actually moving is impossible. But there is also the problem of the amount of time the units are not moving at all. Transportation is a commodity that cannot be stored for a rainy day. What is not used immediately is lost forever. A truck company idle for a day means 30,000 ton-miles' worth of transportation wasted.

We can contribute most to a speed-up of transportation by reducing to a minimum the length of time our transportation units stand idle. When we can load and unload faster, our units make more trips in the same length of time. Even doubling the number of trips, in many cases, is a possibility not beyond reason.

Prompt Delivery Important

Our primary concern is delivering supplies to the consumer when he needs them. Where these supplies are stored is unimportant if we make deliveries on time. By speeding up our transportation we can keep a larger bulk of our supplies at greater distances from the combat zone and still deliver them when and where needed in the same length of time we now require.

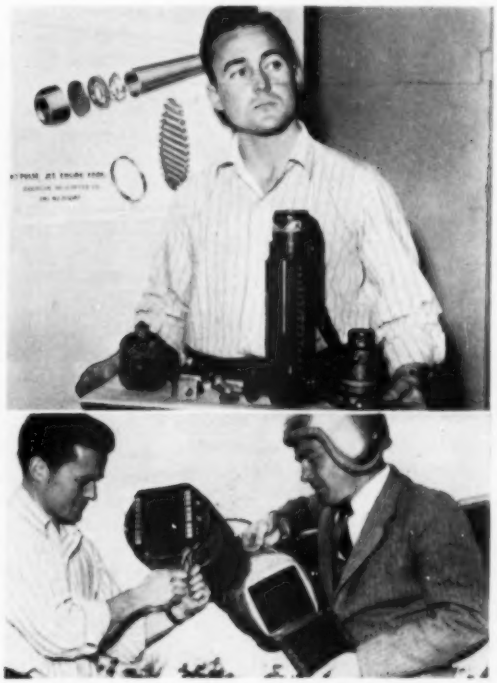
We are faced with the problem of an increased demand for service-troop support for combat forces in oversea theaters at the same time that we have a pressing demand for increased combat manpower. We must continue to render our fullest support, but we must find ways and means to render it with an absolute minimum of service troops.

One of the ways we can reduce our service-troop requirements is by substituting speed for men. Any one devising means to effect this substitution will be contributing substantially to the success of any future military campaign.

The Pulsejet Helicopter

The first successful pulsejet helicopter shown above is powered only by the two tiny jet engines seen on the tips of the rotor blades. It is claimed that the pulsejet helicopter will lift twice the payload of conventional helicopters of comparable size by eliminating the heavy piston engine. The valve block of the pulsejet is the only moving engine component, and the fuel system has only five accessories—fuel pump, throttle, shut-off valve, flow gauge, and rotary transfer seal. It is said that maintenance and overhaul costs should be less than a fourth of similar costs on conventional helicopters. The pulsejet uses low-grade kerosene or jet fuel which greatly reduces fire risks.

The two pulsejet engines required to power this helicopter are so light that they can be held by one man as compared with the heavy piston engine.



The pulsejet helicopter's five fuel-system accessories are shown at the top, above, while, below, the easily replaceable valve block is shown being installed.

Month by Month: High Lights of the National Defense

State of the Union

In his State of the Union message to Congress in January, President Truman called for a potential production of 50,000 planes and 35,000 tanks a year. Aircraft production in January was 250 planes. Peak monthly production in World War II was 9,113 planes.

A World War II B-17 cost $275,000; a modern B-36 costs $3,500,000. Aircraft today are twice as large as and far more complicated than World War II aircraft and take four times as many hours to build.

> *The President stressed the fact that in the defense build-up we are going to produce all the weapons and equipment that 3,500,000 armed services men and women will require.*

"Furthermore," he said, "we will make weapons for our allies, and weapons for our own reserve supplies. On top of this we will build the capacity to turn out on short notice arms and supplies that may be needed for a full-scale war."

The American Ordnance Association will use its entire organization to help production, maintenance, and manpower. The Association is a noncommercial, nonpolitical, and nonprofit society dedicated to national preparedness as the best guaranty of peace.

All Is Not Lost

Are we really as badly off as some calamity howlers pretend we are? Is the international and domestic situation as dark for America as some of the gloom spreaders in the Capital say it is?

> *Tut, tut. Quite the contrary. In other words, NO!*

Highly competent experts believe that we should feed the Nervous Nellies to the lions, that we should put gloom and hysteria in mothballs, that we should start talking about our strength instead of our weaknesses.

Here are a few tonic facts to give us stout hearts and steady nerves:

1. We are a nation of 150,000,000 people with a deep faith in the worth and dignity of every human being, and passionately devoted to freedom and the civilized decencies of day-by-day living. The American tradition of justice and equality is still a mighty force throughout a great continent.

2. Americans possess unrivaled know-how in many fields—scientific, industrial, military. Our citizens are alert and self-reliant. In the event of a major conflict they will constitute a united, formidable, and determined people with immense spiritual and material reserves and with a high degree of competence to slug it out with any slave state on earth.

3. The United States, as in every war in our history, can absolutely rely upon the superiority of our land-sea-air ordnance. Any deficiency in manpower will be compensated for by the quality of our firepower.

In other words, buck up! Americans always get stronger when trouble is brewing.

General Burns Appointed

The Secretary of Defense, Gen. George C. Marshall, has designated a distinguished Ordnance officer, Maj. Gen. James H. Burns (Ret.), as Assistant to the Secretary of Defense for International Security Affairs and has appointed him the Department of Defense representative on the interdepartmental Committee on International Security Affairs.

This Committee was established by a memorandum of the President last December.

> *The memorandum stated, in part, that "the most urgent organizational problem which we now face involves the proper framework in which the questions relating to the North Atlantic Treaty and economic and military assistance programs can properly be coordinated."*

The memorandum designating General Burns as Assistant to the Secretary of Defense for International Security Affairs stated that the suboffices and functions previously assigned to General Burns in his position as Assistant to the Secretary of Defense (Foreign Military Affairs and Military Assistance) are assigned to him in his new position.

New R.O.T.C. Units

New Army Reserve Officers' Training Corps units have been activated at thirty-three colleges and universities in twenty-two States.

Ordnance, Transportation, Military Police, Chemical, Signal, and Engineer units are among those which will be activated.

> *The new units will begin operation at the start of the 1951-1952 school term. They will bring to a total of 235 the number of collegiate institutions at which there are R.O.T.C. units.*

Ordnance units will be activated at the following institutions: University of Connecticut, Florida State University, Dartmouth College, Hofstra College, University of Scranton, Vanderbilt University, Seattle University, Gonzaga University, and Marshall College.

Navy Ship Program

A naval shipbuilding and conversion program, estimated to cost nearly three billion dollars, was unanimously approved by the House Committee on Armed Services.

In addition to the authorization of a large aircraft carrier "not to exceed 60,000 tons," the program calls for:

1. Construction of 173 new ships, including the big carrier, to cost not less than a billion dollars ($235,000,000 for the carrier);

2. Conversion of 291 vessels at a cost of not less than one billion.

It was unofficially estimated that the completed program will cost nearly three billion dollars. A third supplementary appropriation bill, scheduled to be submitted by early March, is planned to provide the money needed now for this program.

Air Force Expansion

Under Secretary John A. McCone of the Air Force believes that the President's goal of increasing military aircraft production fivefold within a year will probably be attained.

Mr. McCone said that peak production would be reached about May 1952 and would continue at a high level for the remainder of the year. This would provide all airplanes contemplated at present, and subsequent production presumably would be cut back to a maintenance basis.

> *The number of air groups will be increased substantially beyond the eighty-four previously announced.*

Procurement contracts have been awarded for ninety per cent of the new planes for which funds were provided in the regular and first supplemental appropriation acts for 1951. These orders amount to about $3.4 billion. New planes will include modifications of existing types and also some new models which have been approved but are not yet in production.

> *In order to secure top production as quickly as possible, existing aircraft plant capacity will be used to the maximum extent, supplemented by available production facilities of other industries, particularly automobile factories and assembly plants.*

In this way the time required for the construction of new plants and the recruitment of labor will be either reduced or eliminated.

It is also planned to have sufficient available stand-by facilities to double aircraft production in the event of an all-out war. Machine tools, jigs, dies, fixtures, and other mechanical equipment will be stored and ready for instant use whenever necessary.

Billions for Defense

The Department of Defense has advised the Director of Defense Mobilization that its current over-all procurement program would cost approximately $87 billion for this and the next fiscal year, over and above such housekeeping items as armed services pay and transportation.

> *This represents the two-year volume of orders to be placed for matériel by June 30, 1952, under the 1951 and 1952 programs as outlined in the President's budget message.*

The procurement program is being computed rapidly in terms of end items which are then translated into the requirements of basic materials. This information, beginning in January, was made available to the Defense Production Administration.

The procurement program will be expedited to the full and will provide initial equipment and matériel needed to:

1. Sustain the training activities for those forces which must be trained in advance to permit the movement of maximum forces into combat in the first year of war;

2. Provide the combat equipment for and the matériel needed to sustain those forces which could be placed in combat overseas during the first year of total war; and

3. Provide the equipment needed for immediate air and naval defense.

> *Provision has been made to supply the forces and needs in Korea. The program will also provide sufficient equipment to meet the training needs of the National Guard and Reserve components not called into active service and to help equip those nations which have joined with the United States to resist aggression.*

Existing reserves will be modernized as necessary, and hereafter equipment now being placed in reserve will be kept modernized.

Small Business Safeguarded

The Department of Defense has reported that of the 1,736,882 purchases of supplies, services, and construction by the military services in the fiscal year ending June 30, 1950, a total of 1,267,000, or 73 per cent, were transactions with small business firms.

> *The report shows that, in dollar value, small business received $1,310,615,000, or 24.5 per cent, of the total of $5,355,396,000 spent for defense orders.*

Small business contracted for 12.7 per cent of the ordnance items. These included parts or equipment used with ordnance items, such as targets, ammunition boxes, grenades, and mines.

Civil Defense

For individual citizens who have been asking, "What can I do?", the American National Red Cross has mobilized its facilities and chapters in coöperation with the Civil Defense Office to carry out three major activities in which every one can take part. These are:

1. The first-aid program, in which some twenty million people should be trained as rapidly as possible;

2. The national blood program, in which the Red Cross will coördinate the efforts of all interested agencies in developing a realistic program of mass procurement; and

3. Nurses' aide and home-nursing training, which will be carried out on a large scale.

Recent testimony before the Joint Congressional Committee on Atomic Energy revealed that today nearly all States have appointed civil-defense directors. In addition, there is a civil-defense director for the District of Columbia, and one for each of the territories. Most of these directors are full-time, paid, and competent officials, not casual part-time employees, and they have authority to act by legislation or by Executive order.

> *Evidence that a number of State legislatures are aware of their financial responsibilities in civil defense is the fact that New York has appropriated $600,000, California $475,000, and Massachusetts $150,000 for civil-defense purposes.*

For the first time since the Indian

wars our homes are in the front lines. As in those heroic days, our civilians and our soldiers are equals again in danger and in responsibility.

You and the FBI

The President of the United States, in restating the responsibilities of the Federal Bureau of Investigation, has called upon all law-enforcement officers, patriotic organizations, and individuals to report information pertaining to espionage, sabotage, and subversive activities to the FBI. With the above in mind the following suggestions are made:

1. The FBI is as near to you as your telephone. The first page of every telephone book in the country lists the nearest office of the FBI. You can communicate with the FBI by telephone, letter, or by calling at the nearest office.

2. If you have any information on sabotage, espionage, or subversive activities, contact the FBI. Furnish all the facts in your possession. Many times a small bit of information has helped complete an otherwise incomplete picture.

3. Facts are what the FBI is interested in receiving—not what a person thinks but what he does to undermine our internal security. Avoid reporting malicious gossip or idle rumors.

4. Do not circulate rumors about subversive activities or draw conclusions from information you furnish the FBI. The data you possess might be incomplete or only partially accurate. By drawing conclusions based on insufficient evidence grave injustices might result to innocent persons.

5. Once you have reported your information to the FBI do not endeavor to make private investigations. This can best be done by trained investigators who have access to data acquired over the years on individuals engaged in subversive activities. Investigations involving internal security require care and painstaking effort. Hysteria, witch-hunts and vigilantes weaken internal security. We all can contribute to our internal security by protecting the innocent as well as by identifying the enemies within our midst. In cases involving espionage it is more important to identify spies, their contacts, sources of information, and methods of communications than to make immediate arrests.

6. Be alert. The greatest defenders against sabotage are the loyal American workmen who are producing the materials and weapons for our defense. They can be the "watchdogs" of defense in every walk of life.

7. The forces which are most anxious to weaken our internal security are not always easy to identify. Communists have been trained in deceit and secretly work toward the day when they hope to replace our American way of life with a Communist dictatorship. They utilize cleverly camouflaged movements, such as some peace groups and civil-rights organizations, to achieve their sinister purposes. While they as individuals are difficult to identify, the Communist Party line is clear. Its first concern is the advancement of Soviet Russia and the godless Communist cause. It is important to learn to know the enemies of the American way of life.

Industrial College

During World War II the Industrial College of the Armed Forces was closed. It is possible that the present emergency and its requirements for personnel could bring about a repetition of the former decision.

It should be noted, however, that the mission assigned the College by the Joint Chiefs of Staff is one of extreme importance, especially during this gray period of uncertain and unpredictable duration.

Rather than close the College, it would seem advisable to speed up its activities in the following three ways:

1. By compressing its present resident courses from 10 months to 8 months, thereby graduating 3 classes of 125 or more students each every 2 years;

2. By accelerating and augmenting the presentation of its Field Economic Mobilization Course;

3. By accelerating and augmenting enrollment in its Correspondence Study Course.

It would further seem advisable that the present courses be continued unchanged through the conclusion of the present academic year—June 1951.

New U.S. Aircraft

The United States Air Force probably will adopt the British light jet bomber, Canberra, Secretary of the Air Force Thomas K. Finletter told a press conference recently. If this action is taken the plane will be put into production in the United States, probably at the Glenn L. Martin plant near Baltimore, Md.

While not disclosing its performance data Mr. Finletter was enthusiastic about the record achieved by the new British plane under test. Its major use would be on all-weather night intruder missions, similar to those now assigned to the American B-26 light bomber in Korea. Development work on the Martin B-51, a light jet bomber similar to the Canberra, will be accelerated, and it is possible that this plane may also be put in production.

Production of the new Northrop F-89, a twin-engined night fighter, will be accelerated. It will be used primarily for air defense. The Secretary indicated that the Air Force would concentrate on all-weather planes to a much greater extent than heretofore. The North American F-86 Sabre jet, which achieved such a fine record in combat in Korea against the Russian-built MIG-15 will be continued in production and will be used largely as a daylight interceptor.

The Air Force will continue to buy modified Convair B-36 heavy bombers, and they will form the backbone of the intercontinental air fleet. The Boeing B-47 Stratojet will continue for some time to be our most advanced medium bomber. However, two experimental models of the new B-52, which is considerably larger and has a longer range than the B-47, are under contract and may be tested this year.

The MIG-15 jet fighter now used by the enemy in Korea is a very fine plane, and indicates that the Russians have the scientific knowledge and engineering skill to turn out progressively finer aircraft, a fact which must be continually kept in mind. Reports from Korea have indicated that our fliers have high respect for Red pilot performance. Nevertheless our F-86 jet fighters are doing extremely well against the MIG's.

Powerhouse of Firepower

An Editorial

WHAT with the panicky talk the country over on the current international muddle a stranger to our shores might think we are the victims of psychological warfare waged by ourselves against ourselves! And he would not be far wrong.

But while it may be later than we think, we are still far stronger than we think. To put it another way—we are much stronger than the pessimists would have us believe.

High on the list of our national assets is the reservoir of capable individuals and well-equipped organizations ready and anxious to lend a hand to our defense leaders. Their availability and service are second in our list of assets to the moral stamina of our people which has not yet been found wanting despite the stresses and strains of two World Wars in the short space of three decades. It is this reservoir of strength of men and machines that constitutes our powerhouse of firepower.

The gigantic appropriations for the ordnance production task of the next few years is best indicated by the attitude of the Congress as reflected in current money appropriations. Having in mind that during the Second World War Army Ordnance alone expended one-half of the dollars available to the Army (which at that time included the Air Force), it is not difficult to foretell that the size and volume of the current production effort for preparedness will be proportionately large.

As of this writing in mid-February 1951, the Congress has appropriated 9½ billions of dollars for Army Ordnance for all purposes including the Military Defense Assistance Program. Supplemental appropriations now under consideration may double these expenditures. The production of military armament for our fighting forces will require approximately one-third of the total funds appropriated, or more than fifty per cent of the entire Army appropriation.

In the face of this great responsibility it is mandatory that the waste, inefficiency, and red tape which marked so much of our national effort in the Second World War be conspicuous by its absence. Out of this present rearmament effort there must come sane and lasting protection—and not a weakening of our American way of life.

The Industry-Ordnance Team

It is not necessary to recall for readers of ORDNANCE the tremendously powerful organization known as the Industry-Ordnance Team which was functioning with precision and efficient effect throughout the Second World War. While much of its machine power was dissipated at the end of hostilities, its mental power remains practically intact. Its arsenals, depots, regional organizations, and advisory boards are available for the most part to continue the job where it was last left off. And with slight refurbishing they can quickly reflect the progress which has characterized our industrial machine in the interval since the last conflict.

It is this progress since we last girded for battle that should give us all renewed courage and hope. Our national productivity of peacetime goods in five short years has grown apace: output per man-hour has jumped exceedingly; gross national product has increased to more than 250 billions of dollars; industrial production has mounted accordingly; civilian employment is at an all-time high.

Supplementing this power and helping to coördinate its effort stands the American Ordnance Association, the facilities of which are today—as they have been during the past thirty-two years—at the complete disposal of our national-defense authorities. This unique organization of more than 32,000 American citizens exists for a single purpose: to strengthen our national-defense structure. Services of its members are entirely voluntary; their objectives are exclusively nonpolitical; their aims are strictly noncommercial. They have divided their activities regionally throughout the United States and today comprise thirty-two local Posts wherein the best brain power of industry and the defense forces meet on common ground.

Technical Divisions and Committees

Through the American Ordnance Association are also available the services of its more than forty-four Technical Divisions and Committees which have been and are in frequent consultation with defense authorities on production-engineering problems covering the entire field of ordnance.

Here again the Association offers for immediate voluntary service many of the best minds and broadest experiences of the ordnance production effort of the last war. These talents and services are ready for the use of the respective ordnance organizations of the Army, Navy, and Air Force.

This state of affairs is as inspiring as it is real. It represents the evolution of an ideal begun forty years ago by Maj. Gen. William Crozier, then Chief of Ordnance of the Army, and carried forward through all the years by his successors in the Army, Navy, and Air Force as well as in industry.

One has only to imagine what our national plight in this hour might be if such a philosophy and such an organization were not in being and at maximum efficiency to uphold the hands of our military leaders.

And so it is that in evaluating our present situation, despite all the muddle of world affairs, we have abundant grounds for hope. We have our American way which has made us morally and physically what we are—a peaceful people whose strength when needed is as the strength of ten. And we still have an Ordnance Team to produce and service in the field superior fighting equipment for superior fighting men. In this arsenal of know-how and of willing coöperation—symbolized by the American Ordnance Association—is our powerhouse of firepower and a strong guaranty of peace.

Officers and Directors of the Amer

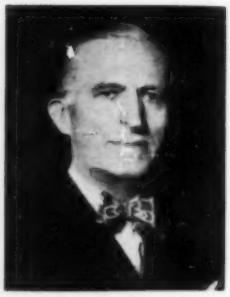
Benedict Crowell
Cleveland, Ohio

"The American Ordnance Association shall be a patriotic, educational, scientific, nonpolitical, and nonprofit-making organization of American citizens dedicated to scientific and industrial preparedness for the common defense as one of our Nation's strongest guaranties of national security and peace."—*A.O.A. Constitution, Article I.*

Herbert A. Gidney
Pittsburgh, Pa.

Levin H. Campbell
Chicago, Ill.

K. T. Keller
Detroit, Mich.



Frederick H. Payne
Springfield, Mass.

R. L. Biggers
Detroit, Mich.

Daniel J. Martin
Houston, Tex.

R. E. Gillmor
New York, N. Y.

Henry P. Erwin
Washington, D. C.

John Slezak
Sycamore, Ill.

C. Stewart Comeaux
New York, N. Y.

Donald F. Carpenter
Wilmington, Del.

Henry L. Clark
South Gate, Calif.

nerican Ordnance Association, 1951

Among the Association's goals: "To assist in effecting industrial preparedness on the part of a strong private free-enterprise system as being one of America's strongest guaranties of peace. . . . To coöperate with all agencies of the Government in planning the mobilization and utilization of . . . scientific and industrial resources for the national security."—*By-Laws, Paragraph 1.*

James L. Walsh
New York, N. Y.

W. W. Coleman
Milwaukee, Wis.

C. Jared Ingersoll
Philadelphia, Pa.

W. H. Blandy
New York, N. Y.

Harvey C. Knowles
Cincinnati, Ohio

Louis Polk
Dayton, Ohio

Edward R. Godfrey
Detroit, Mich.

B. F. Fairless
Pittsburgh, Pa.

John S. Pfeil
Boston, Mass.

J. E. Trainer
Akron, Ohio

Charles D. Wiman
Moline, Ill.

Ben Morcell
Pittsburgh, Pa.

John Ross Delafield
New York, N. Y.

ASSOCIATION AFFAIRS

• **SEMPER FIDELIS.**—In conformity with its practice of long standing, the American Ordnance Association has donated to the United States Marine Corps for the Navy Relief Society the sum of $2,757.23.

This amount represents the excess of income over expenditures incident to the Thirty-second National Dinner Meeting of the Association which was held at the Waldorf-Astoria Hotel in New York City on the evening of December 6, 1950.

More than 1,600 members and guests were present at this meeting which was in tribute to the United States Marine Corps. The guest of honor and principal speaker on that occasion was Gen. Clifton B. Cates, Commandant of the Corps. General Cates' address at the dinner was published in the preceding issue of ORDNANCE.

The check was presented to General Cates at Marine Corps headquarters in Washington on the afternoon of Friday, January 26, 1951. The presentation was made by James L. Walsh, president of the American Ordnance Association. He was accompanied by Henry P. Erwin, treasurer of the Association, and Leo A. Codd, executive vice-president.

General Cates extended his personal thanks and that of the Corps not only for the tribute which was given at the national meeting but also for the very substantial contribution to the Navy Relief Society.

Colonel Walsh expressed the gratification of the Association in having had the opportunity to honor the Corps and its Commandant and explained the long-standing policy of the A.O.A. of always donating any excess of income over expenditures from such meetings to some appropriate charitable, relief, or recreational organization.

He cited the instance of a few months ago when a similar donation was made to the Army Relief Society through Maj. Gen. E. E. MacMorland, Commanding General of the Aberdeen Proving Ground, Md., in connection with the Association's Thirty-second Annual Meeting at Aberdeen in October 1950. An account of this presentation was published in the November-December 1950 issue of this magazine.

The Association is in receipt of the following letter of official thanks for the donation from Vice Adm. V. R. Murphy, executive vice-president, Navy Relief Society. The letter is addressed to Colonel Walsh.

"General Cates, the Commandant of the Marine Corps, has forwarded to the Navy Relief Society the most generous and thoughtful contribution of the American Ordnance Association in the amount of $2,757.23, representing the excess of income over expenditures connected with the Ordnance Association's dinner.

"This donation is most timely in that it comes at a critical period when the work of the Society is assuming increasing importance as a vital factor in the welfare and morale of our Navy and Marine personnel and their families. The interest and support of your organization and its members is deeply and sincerely appreciated. We will endeavor to give it real meaning to those who find themselves in need of help.

"It is especially gratifying to know that the members of the Association, who have made and are continuing to make such a substantial contribution to material preparedness, are equally prepared to assist with the problems of the human element of the country's defense. You may be assured that the donation is no less appreciated in itself than for the inspiration this knowledge provides. I am sure we will all do better work because of it.

"We are grateful, also, at having been so appropriately and generously remembered on the occasion of your tribute to the United States Marine Corps. The spirit and devotion which the Marine Corps so highly exemplifies is an ever-present example and spur to our efforts.

"On behalf of both the Board of Managers of the Navy Relief Society and the thousands of men and women of the Navy and Marine Corps, please accept our most sincere thanks to you and the members of the Association. It is only through the kind and unselfish consideration of those truly devoted to our country's interests that our work can go on."

• **BIRMINGHAM POST.**—A panel of experts on ordnance production and procedures featured the annual meeting of the Birmingham Post, A.O.A., held at the Birmingham Country Club, Birmingham, Ala., January 19, 1951. R. C. Stobert, president of the Hardy-Tynes Manufacturing Company, presided. Col. William J. Rushton, chief of the Birmingham Ordnance District, and Col. C. Wingate Reed, deputy chief, were the principal speakers.

The panel of ordnance experts consisted of Col. W. W. Storey, comptroller, Office of the Chief of Army Ordnance; Col. A. J. Lazure, chief of the Legal Di-

U.S.M.C.

Gen. Clifton B. Cates, Marine Corps Commandant (center), accepts a $2,757.23 check from James L. Walsh, A.O.A. president (second from right), which the Association donated to the Navy Relief Society. Lieut. Gen. Lemuel C. Shepherd, Jr., Commanding General, Fleet Marine Force, Pacific (left); Henry P. Erwin, A.O.A. treasurer; and Leo A. Codd, executive vice-president of the Association (right), witness the event at Marine Corps headquarters.

vision of Army Ordnance; Richard B. Cross, executive office of the Secretary of the Navy; R. M. Koepsell of the Munitions Board, Office of Mobilization Planning; Lieut. Col. Donald C. Beck of the Industrial Division, Office of the Chief of Army Ordnance; and Capt. D. R. Giles, supervising inspector of Naval Materials, Atlanta, Ga. Hugh P. Bigler, former president of the Post acted as moderator.

At a business meeting preceding the panel discussion a new constitution for the Post, presented by Col. Roy D. Hickman, was unanimously adopted, and an election of officers was held.

Leo A. Codd, A.O.A. executive vice-president (right), presents charter of the new Lansing Chapter of the Michigan Post to Lester F. Carlson, Chapter president (left). Looking on are S. E. Skinner (second from left), Rear Adm. John A. Snackenberg, and Dr. Kenneth D. McFarland, all of whom spoke at the inaugural meeting.

• **LANSING CHAPTER.**—When the last issue of ORDNANCE went to press there was not time to include a complete account of the establishment of the Association's newest Chapter at Lansing, Mich. The Chapter was formed on November 29, 1950, at a dinner meeting held in the main dining room and auditorium of the Oldsmobile plant. The new Chapter is a unit of the Michigan Post—the Association's largest regional organization. The committee for the formation of the new Chapter was under the chairmanship of Henry J. Sullivan of Detroit. A belated but complete account of the inaugural ceremonies follows:

The Lansing Chapter of the Michigan Post, American Ordnance Association, was formally installed November 29, 1950, at a dinner attended by more than 600 members and guests in the Oldsmobile Engineering Auditorium at Lansing, Mich. Leo A. Codd, executive vice-president of the A.O.A., presented the Chapter's charter to Lester F. Carlson, Chapter president and executive assistant to the general manager of the Oldsmobile Division, GMC.

Rear Adm. John A. Snackenberg, Deputy Chief of the Navy's Bureau of Ordnance, and Dr. Kenneth D. McFarland, superintendent of schools in Topeka, Kans., were the principal speakers at the meeting.

"We have the opportunity through the American Ordnance Association," Admiral Snackenberg told the group, "to identify the industrial strength of the United States so intimately with the measure of military power that they may be called factually 'one and inseparable.' We must, I feel, present in this light our part of the picture of the national potential for the conduct of war. No country in the world can fail to comprehend the implications if our industry is prepared to divert its strength rapidly and completely from the production of the plowshares of peace to the sharp swords of war—especially if this capability is made widely known by appropriate means."

Admiral Snackenberg welcomed the Lansing Chapter to the A.O.A. on behalf of the armed forces. He also praised S. E. Skinner, Oldsmobile general manager, as the real inspiration behind the formation of the Lansing group and cited the work done by Mr. Skinner and Oldsmobile in World War II.

Dr. McFarland said that "business as usual" is out for the duration, and he forecast national-defense expenditures of $50 billion annually.

Mr. Skinner pointed out that the Nation faces a period of "combined operations" in which a robust civilian economy must be maintained while the country is arming itself for its own self-protection. He asserted that whatever our boys in service need will have an overriding priority as far as the members of the Michigan Post of A.O.A. are concerned.

C. W. Otto, secretary of the Lansing Chamber of Commerce, presided at the meeting. Officers and directors of the Lansing Chapter were introduced. They included Eldon Robbins, of the John Bean Division, Food Machinery & Chemical Corporation, executive secretary; Lee O. Benner, Motor Wheel Corporation; Clarence A. Trump, Fisher Body Division, GMC; Fred Marin, Bank of Lansing; and Barney C. Cox, Melling Forging Company. Glen Whisler, Reo Motors, Inc., Chapter treasurer, was unable to attend.

Members of the A.O.A. from Detroit, Grand Rapids, Kalamazoo, and Ann Arbor were in the large audience present. These included Robert Briggs, vice-president of the University of Michigan; and George Roderick of the American Seating Company, Grand Rapids, both directors of the Michigan Post.

Preceding the addresses, the Army combat film, "First Forty Days," was shown.

• **NEW YORK POST.**—The Industrial Preparedness Committee of the New York Post, under the chairmanship of Maj. Gen. R. L. Maxwell, visited the Ward Leonard Electric Company in Mount Vernon, N. Y., on January 12, 1951, to learn about that company's participation in the Nation's industrial mobilization planning effort. The visit was cosponsored by the National Security Industrial Association.

The meeting was attended by: Maj. Gen. R. L. Maxwell, vice-president, American Machine & Foundry Company; Col. C. K. Allen, assistant district chief, New York Ordnance District; A. M. Hanssen, National Security Industrial Association; P. R. Bassett, president, Sperry Gyroscope Company; Vice Adm. G. F. Hussey, Jr., president, New York Post, A.O.A.; Commodore J. K. Richards, executive director, National Security Industrial Association;

Col. Henry N. Sachs, Frank Crystal & Company; Frederick Tompkins, president, Newark Plaster Company; Col. John Walker, deputy district chief, New York Ordnance District; Victor J. Zaro, executive assistant to the manager, contract division, American Machine & Foundry Company; C. F. Denney, general production manager, Foster Wheeler Corporation;

Leonard Kebler, chairman of the board, Ward Leonard Electric Company; Arthur A. Berard, president, Ward Leonard Electric Company; A. W. Borghard, vice-president, Ward Leonard Electric Company; F. E. Beede, sales manager, Ward Leonard Electric Company; C. B. Stockton, assistant to the president, Ward Leonard Electric Company; E. S. VanArnan, factory manager, Ward Leonard Electric Company; W. J. Gregoritch, chief of production, Allocation Branch, Industrial Planning Section, New York Air Force Procurement Office.

After an interesting plant tour, the committee had lunch at the near-by Pelham Country Club and heard an address by Mr. Berard.

Ward Leonard's expansion in World War II was tremendous. Sales jumped

from $2,000,000 to $22,000,000 a year. Employment rose from 500 to 3,000. Plant area was expanded from 100,000 square feet to 400,000 square feet. At the height of the war, operations were scattered in twenty-eight different locations.

To avoid repeating the frenzied expansion experienced in World War II, Ward Leonard submitted its "Industrial Facilities Survey" to the Munitions Board outlining its production potential with present facilities and, in addition, submitted plans for a "phantom plant" which will be required to handle the anticipated wartime production load.

This was the fourth plant visit of the Industrial Preparedness Committee, the prior ones being held at International Business Machines Corporation, Sperry Gyroscope Company, and U. S. Pipe and Foundry Company.

• **MID-CONTINENT MOBILIZATION CONFERENCE.**—The Mid-Continent Post of the Ordnance Association joined hands with the Oklahoma City Chamber of Commerce in the presentation of a mobilization conference at Oklahoma City, on January 9, 1951. An entire day was devoted to the subject, including a visit to Tinker Air Force Base.

James Bush, chief of the St. Louis Ordnance District, and Lieut. Col. J. D. Childs, deputy chief, inspected industrial facilities in the area. At a meeting in the evening at the Skirvin Hotel, Ross Pancoast, Army Ordnance expert on pricing and renegotiation in the Ordnance Office at Washington, described the current procurement policies of Army Ordnance and participated in a lengthy question-and-answer period.

He described methods of financing defense contracts and plant expansions, and the procedures regarding prime and subcontracts, pricing policies, and renegotiation.

M. H. Johnson, president of the Post, who is also president of the Independent Plow Company, Neodesha, Kans., presided.

Following a directors' meeting of the Mid-Continent Post and luncheon, members and guests were taken to Tinker Air Force Base for an inspection of the vast facilities there for maintenance and rehabilitation of equipment by the United States Air Force. It is the largest installation of the Air Matériel Command in the world.

Through the kindness of Maj. Gen. Fred S. Borum and the officers of his staff the Ordnance visitors were enabled to obtain a broad and accurate picture of the operations conducted at this important establishment.

From 5 to 7 p.m. there was a conference on procurement matters conducted in the Skirvin Hotel under the auspices of Mr. Bush and Colonel Childs. At 7 p.m. there was a dinner meeting at which Mr. Pancoast's paper was presented.

It will be published separately as a special report of the Ordnance Association and will be mailed shortly to all company members. Individual members who desire copies may obtain them upon request to the editorial offices of the Association, Mills Building, Washington 6, D. C.

• **CHARLES E. WILSON.**—All members of the Ordnance Association will join in expressions of congratulation to Charles E. Wilson, formerly president of the General Electric Company, who is now Director of Defense Mobilization. Mr. Wilson is a member of the Advisory Board of the Ordnance Association and in 1948 was awarded the Association's gold medal for merit for his outstanding contribution to the industrial-mobilization effort in the Second World War.

C. E. Wilson

As Director of Defense Mobilization, Mr. Wilson will be general director of all activities of the Government for the utilization of our industrial power to maximum effect. He has stated his function to be one of policy and the coördination of the various operating agencies. His office will be composed of a small group of highly qualified persons to assist him in the formulation of policy and in the coordination of the efforts of all agencies responsible for mobilization activities.

Mr. Wilson was associated with the General Electric Company for more than fifty years. His life and work symbolize the opportunities and responsibilities of individual initiative in our national economy.

Mr. Wilson was born in New York City, November 18, 1886, and was educated in the public schools there. In September 1899 he began his phenomenal career in the shipping department of the Sprague Works, General Electric Company, in New York and thereafter served successively in accounting, production, engineering, manufacturing, and marketing operations.

From 1930 to 1937 he served as manager of the merchandise department and a vice-president of the company, becoming executive vice-president in 1937 until he assumed his present governmental office. He had been president of General Electric since January 1, 1940, except during his tenure as Executive Vice-Chairman of the War Production Board from September 1942, to September 1944.

He was also chairman of the Board of the General Electric Supply Corporation and a director of the General Electric Company, the International General Electric Company, and of the Guarantee Trust Company of New York. Upon assuming his present duties Mr. Wilson relinquished all these connections.

Mr. Wilson's acceptance of his new responsibilities has met with the general acclaim of his countrymen and augurs well for the conduct of the vast armament operations upon which the Government of the United States is now embarked.

• **MILWAUKEE POST.**—Maj. Gen. James Kirk, Assistant Chief of Ordnance, was the principal speaker at the annual meeting of the Milwaukee Post, A.O.A., January 19, 1951. A large and representative gathering of the Milwaukee-area manufacturers was on hand at the Hotel Pfister to hear the General who was presented by Col. Frederick D. Hansen, president of the Post.

Others who participated in the meeting were Col. S. R. Stribling, chief of the Chicago Ordnance District, and James L. Walsh, president of the American Ordnance Association.

Colonel Stribling announced that a suboffice of the Chicago Ordnance District will be opened shortly in Milwaukee. It will handle all inspection duties in that area and will later conduct production and engineering activities. He also announced that in the Milwaukee area there are now in effect about 300 ordnance production operations valued at about $100 million. During the Second World War the Milwaukee area was responsible for about twenty-five per cent of the operations of the Chicago Ordnance District.

As chief of Ordnance Field Service, General Kirk described the increasing difficulties of supplying our armed forces from current stocks. He emphasized especially the critical situation brought about by the need for ordnance spare parts.

He also stressed the huge rehabilitation program being conducted by the Ordnance Department, emphasizing the great savings that are being made. Replacement of some ordnance items at current costs would be in excess of 400 per cent of the original cost.

• **MEETINGS TO COME.**—As this issue goes to press early in February, several important meetings to be held during the month of February cannot be reported until the next issue.

The Philadelphia Post of the Ordnance Association will hold a meeting at Reading, Pa., on February 7th. On that day a special train will be operated from Reading Terminal, Pa., to the Parish Pressed Steel Company in Reading.

Members and guests will spend the afternoon inspecting the facilities of the plant and that evening will meet to hear an

address by Adm. W. H. P. Blandy, former Chief of the Bureau of Ordnance of the Navy, commander of the Atlantic Fleet, and director of the atomic bomb tests at Bikini.

Plans for the meeting are in the hands of a committee under the chairmanship of Maj. Gen. G. M. Barnes, former chief of Research and Development of Army Ordnance and now vice-president of the Budd Company, Philadelphia.

On February 21st, at historic Charleston, S. C., a new Post of the Ordnance Association will be formed at The Citadel —Charleston's famed military school. James L. Walsh, president of the A.O.A., will present the charter. Maj. Gen. James Kirk, chief of Ordnance Field Service of the Army, will represent Maj. Gen. E. L. Ford, Chief of Ordnance, at the ceremonies.

The new Post is being formed under the direction of Col. John M. Madison, professor of military science and tactics at The Citadel, and Maj. G. D. Stephens, Ordnance Corps.

It is particularly appropriate that a new Post of the Association be formed at The Citadel, or, as it was formerly known, the Military College of South Carolina. Gen. Charles P. Summerall is president of the school and Maj. Gen. T. L. Futch is superintendent.

On February 20th the annual meeting of the Board of Directors of the American Ordnance Association will be held in Washington, D. C. This is the budget and policy meeting at which time the recently elected new directors will formally take office. The board now consists of:

Robert L. Biggers, Fargo Division, Chrysler Corporation, Detroit, Mich.;
W. H. P. Blandy, The Health Information Foundation, New York, N. Y.;
Levin H. Campbell, International Harvester Company, Chicago, Ill.;
Donald F. Carpenter, E. I. du Pont de Nemours & Company, Wilmington, Del.;
Henry L. Clark, General Motors Corporation, South Gate, Calif.;
W. W. Coleman, Milwaukee, Wis.;
C. Stewart Comeaux, Sporting Arms & Ammunition Manufacturers' Institute, New York, N. Y.;
Benedict Crowell, Crowell & Murray, Cleveland, Ohio;
Henry P. Erwin, Hibbs Building, Washington, D. C.;
B. F. Fairless, U. S. Steel Corporation of Delaware, Pittsburgh, Pa.;
Herbert A. Gidney, Gulf Oil Corporation, Pittsburgh, Pa.;
R. E. Gillmor, Sperry Corporation, New York, N. Y.;
E. R. Godfrey, General Motors Corporation, Detroit, Mich.;
C. Jared Ingersoll, Kansas, Oklahoma & Gulf Railroad Company, Philadelphia, Pa.;
K. T. Keller, Chrysler Corporation, Detroit, Mich.;
Harvey C. Knowles, Procter & Gamble Company, Cincinnati, Ohio;
Ben Moreell, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.;
F. H. Payne, Colony Club, Springfield, Mass.;
Louis Polk, Sheffield Corporation, Dayton, Ohio;
John Slezak, Turner Brass Works, Sycamore, Ill.;
J. E. Trainer, Firestone Tire & Rubber Company, Akron, Ohio;
James L. Walsh, University Club, New York, N. Y.;
Charles D. Wiman, John Deere & Company, Moline, Ill.

• **CHARLES H. TENNEY,** a charter member of the American Ordnance Association and a member of its Advisory Board, died at Springfield, Mass., February 7, 1951. Since the formation of the Association in 1919, Colonel Tenney had served continuously as either a director or a member of the Advisory Board. He was a leader in Ordnance affairs throughout New England during the decade following the first World War, notably as civilian chief of the Boston Ordnance District.

Starting his business career at the age of 18 in the investment field, he became identified with public utilities in 1900 as president of the Malden, Massachusetts, Electric Company. At the time of his death he was chairman of the boards of seven utility companies and a prominent figure in the utility industry in the northeastern section of the United States. He was chairman of Concord Electric Company, the Exeter & Hampton Electric Company, the Fitchburg Gas & Electric Light Company, the Pike County Light & Power Company, the Rockland Light & Power Company, the Brockton Gas Light Company, and the Springfield Gas Light Company.

Colonel Tenney served in the First World War as chief of the Finance Division of the Ordnance Department in Washington and later served overseas in the same capacity. Toward the end of that war he organized and was chairman of the Ordnance Salvage Board. For his service he was awarded the Distinguished Service Medal. In the Second World War he was chairman of the advisory board of the Boston Ordnance District.

The American Ordnance Association was the recipient of unfailing support and guidance from Colonel Tenney throughout the formative years of its existence. He was one of that group of industrial leaders who formed the Association in 1919 and whose support of its philosophy and ideals was responsible for the firm foundation on which it was built. The public-utilities industry was also the recipient of his guiding influence, and it can share with the Ordnance Association the deep sense of loss both have sustained.

• **WALTER GEIST,** president of the Allis-Chalmers Manufacturing Company and a director of the Milwaukee Post, American Ordnance Association, died at Milwaukee on January 29, 1951. He had long been connected with the Ordnance Association, had participated in many of its activities in war and in peace, and was a constant supporter of its plans and policies for the advancement of our national defense.

Mr. Geist headed the Allis-Chalmers Manufacturing Company for the past nine years. Under his leadership that great industrial organization attained new heights in the production of equipment for the Army, Navy, and Air Force during the Second World War.

He was largely responsible for the company's program of social and economic progress among its employees. Under his guidance, the original pension program applicable to the 30,000 employees of the company was begun. During the Second World War he sent Christmas gifts of ten dollars each to the 7,500 Allis-Chalmers employees who were in uniform.

Born in Milwaukee of Norwegian parents, Walter Geist gained his education through evening study and correspondence schools. He began as an errand boy with Allis-Chalmers at the age of 15. He progressed through various positions as designer, engineer, sales manager, president, and director of the company.

Through all the years, Mr. Geist gave generously of his counsel and support to the progress of Ordnance and the advancement of industrial-mobilization preparedness. The Ordnance Association was especially fortunate in having his assistance on many of its projects.

His forceful leadership and energy as well as his personality will be missed by his associates in the Ordnance fraternity, and in American industry generally, for he was a benevolent leader of men.

• **NOTICE** also has been received of deaths of the following members of the Association: W. M. Barr, Detroit, Mich.; Joseph M. Bing, New York, N. Y.; Albert A. Breault, Cohoes, N. Y.; Charles F. Courtney, Lancaster, Pa.; Frank D. Dolan, Aberdeen Proving Ground, Md.; J. N. Garwood, Dayton, Ohio; R. Martin, Winston-Salem, N. C.; John H. Mueller, Detroit, Mich.; John A. Pfeffer, Easton, Pa.; Francis B. Rein, Terre Haute, Ind.; Warren W. Rhoda, Allentown, Pa.; W. G. Robbins, Detroit, Mich.; Fred L. Smith, Aberdeen, Md.; Norman Tice, Derby, Conn. To their relatives and friends, ORDNANCE extends condolences.

MERIT AWARD
Pemco Corporation
GRANTED BY THE NATIONAL BOARD OF GOVERNORS FOR LEADERSHIP IN FORMULATION, FACILITIES AND PROCESSES IN THE CERAMIC INDUSTRY
AMERICAN SOCIETY OF INDUSTRIAL ENGINEERS

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PEMCO CORPORATION has been signally honored by the American Society of Industrial Engineers with the coveted Merit Award for "Leadership in Formulation, Facilities and Processes in the Ceramic* Industry". In this field, only Pemco has merited this unusual distinction because it has been directly responsible for the development of more new and outstanding products for the industry than any other frit manufacturing company. Pemco has just completed a $250,000 expansion program to keep pace with the demands which such leadership imposes. The presentation of this award backed up by the experience gained in the production of vital defense products in two previous world wars is another indication of Pemco's ability to serve the United States in the current national defense emergency. Write for Pemco's "Manual on Facilities for War Work".

*Manufacturers of "The World's Finest" PORCELAIN ENAMEL AND CERAMIC FRITS, PORCELAIN ENAMEL, CERAMIC AND GLASS COLORS, AND RELATED PRODUCTS.

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New Developments

COLD-WEATHER UNIFORMS

A new cold-weather clothing assembly for Army troop wear under field and combat conditions has been approved for future issue. Developed by the Quartermaster Corps, the new ensemble, like the present "wet-cold" field uniform, follows the layer principle. This provides for layers of woolen clothing beneath outer cotton garments which are wind-resistant and water-repellent. The new assembly, however, eliminates one garment from the present uniform and utilizes new items which are lighter in weight yet afford greater protection from the weather than the winter uniform now in use.

Included in the new uniform is a double-faced frieze liner for the field jacket. The liner replaces the present pile jacket. Another new component is a loose-cut wool shirt with square tails which may be worn either inside or outside the trousers. The present high-neck sweater will be eliminated. Also included in the new uniform is pajama-type underwear of much looser design than present winter underwear.

RADIATION MONITOR

A new atomic radiation detector to permit direct radiation readings at a glance has recently been developed. Called a "radiation monitor," the new instrument weighs less than a pound and is about the size of a quart oil can. It is equipped with a self-contained power source, and has neither tubes nor batteries. Radiation measurements are read from the monitor simply by noting the position of a pointer as it moves across a graded scale. The speed at which the pointer moves across the scale is in proportion to the strength of radiation, and the distance it moves in a given time indicates the amount of radiation to which the instrument has been exposed during that time.

NEW FIELD WIRE

A new type military field communication wire is proving effective in combat. Recently developed by the Army Signal Corps and now being produced in quantity by industry, the new wire has withstood all the rugged conditions encountered in Korea. It can be laid at speeds up to 120 miles an hour from airplanes with good results. The improved wire provides a talking range of approximately 12½ miles and weighs about 46 pounds per mile. It consists of two conductors, each individually insulated and jacketed, and twisted together to form a light flexible, flat-lying "twisted pair."

SMOKELESS JATO

A new JATO aircraft booster rocket, which uses smokeless powder and weighs considerably less than present models, has been developed for the Navy for use on various military aircraft. The Army and Air Force also contributed funds for development of the new JATO units, and all three services plan to use them. The use of smokeless powder as a JATO propellant will be particularly advantageous aboard aircraft carriers where clouds of smoke given off by units now in use may hamper operations.

FOR 26,000,000 FEET

Approximately 13,000,000 pairs of footwear will be procured by the Army Quartermaster Corps to meet current needs of the Army and Air Force. This tentative estimate does not include items presently being purchased, and is subject to future modification. Nineteen items listed range in quantity from 6,230,000 pairs of combat boots down to 1,000 pairs of women's rubber overshoes.

HELICOPTER PILOT

The Navy has developed the first successful automatic pilot for helicopters—a device that is expected to increase the utility of rotor-wing aircraft. Routine operation of helicopters at night or during "instrument" weather heretofore has not been considered safe because of the difficulty of maintaining constant stability. The new automatic pilot will make possible normal instrument flight and will decrease pilot fatigue during long trips under adverse conditions.

MICROWAVE COMMUNICATIONS

A $1,300,000 order was recently placed by the U. S. Army Signal Corps for transportable microwave communications equipment. Incorporating the best features of both radio and telephone communication, the equipment may help speed the day when soldiers can completely stop stringing and protecting long telephone lines from battle fronts to rear areas. The Signal Corps order includes equipment for terminal and repeater stations, with complete stand-by equipment for each. These radio stations will provide the Signal Corps with a number of communication systems, each capable of carrying eight telephone conversations in either or both directions at once, via a single radio channel for each direction.

DIELECTRIC TESTER

In order to meet ASTM specifications for testing the dielectric strength of tapes, a device has been developed at Frankford Arsenal, Philadelphia, Pa., which would apply an AC voltage to the specimen under test at a constant rate of rise. Upon breakdown, the high-voltage circuit cuts out automatically, but the breakdown voltage indication is maintained on a voltmeter until the unit is reset. Developed equipment includes a reversible synchronous motor-driven variac equipped with electric braking and limit switches, high-voltage transformer, electrode potential indicating voltmeter, electronic extinguishing circuit incorporating necessary relays, switches, and panel lights.

ARCTIC SHELTER

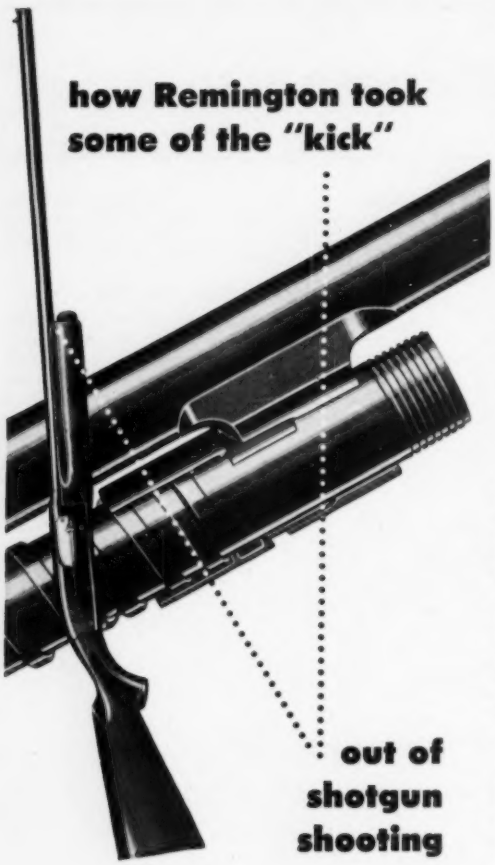
Complete protection from 100-mile gales and subzero weather is provided for soldiers by a new aluminum prefabricated building developed by the Army Engineer Research and Development Laboratories at Fort Belvoir, Va., in collaboration with Chrysler Corporation. It is a box-shaped structure with flat roof that can be erected quickly in the field. It is twenty feet wide and eight feet high, and can be any multiple of eight feet in length that may be desired. The unit recently under test is forty-eight feet long.

AUTOMATIC SOS

An aircraft device which sends distress signals automatically from a plane in flight when an emergency exists has been developed by the Air Matériel Command, Dayton, Ohio. When turned on by a crewman, the instrument automatically switches to emergency frequency, signals SOS three times, gives the aircraft call sign, and sends a series of 4-second dashes spaced one second apart, repeating the whole sequence until turned off or made inoperative.

NEW CRASH BOAT

The Air Force has accepted delivery of a new crash boat officially designated "rescue boat Mark I." The 40-foot craft was designed and built by the Navy and features a hinged transom at the stern



Nobody likes recoil or "kick" in a shotgun. It makes beginning shooters flinch. Even old-timers get a sore shoulder after a long day of shooting. So Remington designers took much of the kick out of shotguns when developing their new autoloaders, the "Sportsman-48" and "Model 11-48."

They developed an ingenious recoil reducing system which changes the quick kick into a slow-motion nudge. This new mechanism is equally effective when using light or heavy loads.

The unusual design of the new Remington autoloading shotguns is another example of progressive Remington engineering . . . the same engineering that created eight new guns in four years.

The Oldest Gunmakers in America
Present the Newest Guns

Remington

DUPONT

"Sportsman" is Reg. U.S. Pat. Off. by Remington Arms Company, Inc., Bridgeport 2, Conn.

which can be lowered into the water to provide a working platform to bring survivors aboard. The transom can be lowered to about eighteen inches under the water, and a litter can be placed under an injured man so that rescuers can slide him gently up the ramp and into a cabin equipped with hot and cold running water, electric heating facilities, blood plasma, and drugs.

ELECTROPHOTOGRAPHY

Development of a new-type camera using invisible electrical images which can produce on-the-spot pictures even in active atomic radiation areas without being fogged, has been sponsored by the Signal Corps Engineering Laboratories. The new camera produces a finished 4- by 5-inch picture two minutes after the shutter is snapped. Its plates, which need no chemicals for processing, can be used over and over again merely by wiping off the image.

The picture has tones similar to that of an ordinary black-and-white photograph and can be printed on paper, wood, cloth, glass, plastics, or ceramic materials. It can be made into a transparency from which enlargements can be produced.

The camera employs the newly discovered electrostatic, electrophotographic process in which light is recorded on a selenium-coated metal plate that has been sensitized by an electrical charge. Where the light hits the charged plate, the electricity leaks off the sensitized material in proportion to the amount of light received and is grounded on the plate. What is left is an invisible electrical image.

Finely ground charcoal or anthracite coal powder is then blown across the face of the plate. Wherever there is electricity on the plate the dust sticks—the more the electricity, the more powder remains. The powdered image is then transferred to ordinary paper or other material coated with an adhesive layer such as rubber cement. To protect the surface and fix the print a clear transparent plastic film is pressed against the picture.

Need for a darkroom in the field will be eliminated as the entire process is done in the back of the camera within two minutes. The plates are not sensitive to light until electrically charged in the back of the camera, and a small supply of plates can be used over and over again.

The camera uses an ordinary lens and shutter. Its light source is the same as for an ordinary camera. The speed of the sensitive plate is about the same as that of regular orthochromatic black-and-white film.

MOST POWERFUL TURBOJET

Claimed to be the most powerful turbojet engine in the world, the J40 recently successfully completed its ground qualification tests.

Designed and built by the Westinghouse Electric Corporation under the guidance of the Navy's Bureau of Aëronautics, the new engine has a thrust equivalent to 14,000 horsepower at modern flight speeds. The addition of an afterburner to reheat exhaust gases after they leave the turbine and before emerging as jet thrust from the tail, together with other developments now in progress, is expected to almost double this figure.

The new engine, weighing less than 3,000 pounds, developed for the Navy, is completely electronically controlled. Despite its huge power, the new jet uses less fuel per pound of thrust than its predecessor, the J34 turbojet which powers some of the Nation's fastest planes. It packs more potential speed into less space than any previous jet engine ever built.

Operation of the J40 in any high-performance military plane is expected to be simpler for the pilot than heretofore. The engine's electronic control system is completely integrated and automatic, from standstill to top altitude and speed. From starting to full power, and under any condition of flight or altitude, operation of the engine is accomplished with a single cockpit

Heavy Duty Trailers

Receptacles and Cookware

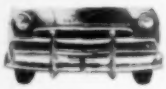
Solderless Milk Cans

Steel Freight Cars

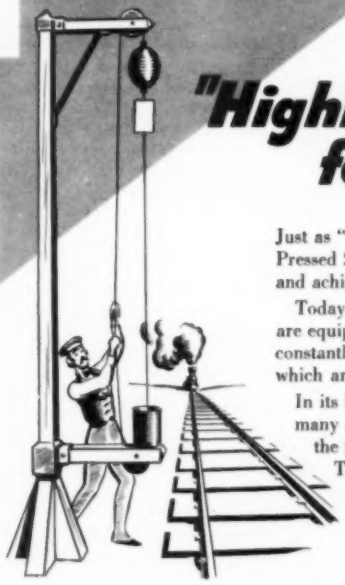
Milk Can Washing Equipment

The new Cellular Laminated Unicel Refrigerator-Box Car

Stainless Steel Milk Strainers



Automobile Grille Guards



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Greater durability and accuracy are provided by the stainless steel, one-piece spindle and screw with hardened and ground threads. Easier, more accurate reading is made possible by the widely-spaced divisions, large-size thimble, black graduations, and dull chrome finish. Long-wearing carbide measuring faces assure enduring accuracy.

See these new micrometers at your tool suppliers. For illustrated folder describing the completely new line of Brown & Sharpe Micrometers, write Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

FEATURING

- Carbide measuring faces
- Larger diameter thimble
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control equivalent to a throttle. All engine conditions are, in turn, automatically tied to this control.

NEW CARRIER-BORNE JET

A new carrier-based jet fighter designed specifically for high-altitude interception has passed its initial flight tests successfully. The new plane, designated the XF4D, is tailless and is actually

U. S. Navy

The XF4D carrier-borne jet interceptor.

a triangular-shaped platform wing with a slim nose extending forward to provide a cockpit for the pilot.

The plane is designed to be catapulted from carrier decks and to climb rapidly to the upper atmosphere to intercept an enemy on short notice.

MORPHINE SUBSTITUTE

Methadone is the name of a new synthetic pain-killer which may supplant morphine. The new drug is made from cheap, common chemicals called nitriles. Grain for grain, it is the exact equivalent of morphine in relieving pain. There is plenty of it now and it can be made in any needed amounts.

Methadone was developed in Germany during World War II at the I. G. Farbenindustrie. Our Army, heretofore always concerned over a possible shortage of morphine, pushed trials of it in cooperation with the National Research Council and the National Institute of Health.

ANTIRADIATION DRUG

Discovery of a drug injection that may provide internal protection against atomic rays has been reported by three British government researchers. The drug is thiourea, a substance commonly obtained by heating urea, one of the main constituents of animal urine. In experiments carried on at the government atomic laboratory in Harwell, mice were injected with the drug and then exposed to normally lethal doses of X-rays. Of nine mice so treated, eight survived.

Mortality among mice either untreated or injected with a variety of other drugs ranged from 14 to 100 per cent.

JET AUTOPILOT

An electrical "copilot" has been developed that will guide America's newest all-weather jet fighter plane through loops, rolls, and other combat maneuvers with split-second accuracy. Scientists and engineers of the Westinghouse Electric Corporation teamed up with flight engineers of the Air Matériel Command's Armament Laboratory to develop the autopilot. Described as the first automatic pilot with "unlimited maneuverability," the midget device will be installed in the F94C fighter plane being built for the U. S. Air Force by the Lockheed Aircraft Corporation. Unflustered by great bursts of speed or abrupt changes of

IT'S "LOADED" WITH BETTER TELEPHONE SERVICE

Twenty of the Bell System's newest small loading coils—like the one at the left—are housed in the long black case, mounted in a cable splice. This type of installation permits the economical extension of city cables to serve out-of-town subscribers.

MANY more wires can be crowded into a cable sheath when the wires are fine. But normally, wires don't transmit as well when they are fine and closely packed.

Bell engineers long ago learned to make wires do better work by loading them with inductance coils at regular intervals. The coils improve transmission and let messages travel farther. But originally the coils themselves were large, heavy and expensive. The cases to hold them were cumbersome and costly too.

So year after year Bell scientists squeezed the size out of coils. To make magnetic cores of high permeability they developed Permalloy. Tough but extra-thin insulation permitted more turns to a core.

New winding machines were developed by the Western Electric Company. Coil size shrunk to one-fiftieth. Some—like the one shown above—can be mounted right in cables themselves.

The 15,000,000 coils in the Bell System today mean thinner wires, more wires in a cable—more economical service for you. They demonstrate once more how Bell Telephone Laboratories work continually to add to your telephone's value.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST

direction, the autopilot also will take complete control of the plane during level flight.

The jet plane version of the autopilot is exceptionally light. It weighs less than one-third the weight of conventional automatic pilots. It is a "first cousin" of the stabilizers developed by Westinghouse during World War II to enable tanks to fire accurately even while bumping along over rough ground. Where manual controls would require perhaps a 50-pound force on the stick and rudder to effect such maneuvers, the flight controller of the autopilot enables the human pilot to achieve the same effect with practically no effort on a single control knob.

NEW CRYSTAL

A revolutionary discovery that promises to make possible for the first time the high-speed, automatic X-ray inspection of thousands of industrial products was recently announced. The heart of the new inspection system is a tiny crystal, known as a "semiconductor," which can be grown from a fraction of a millimeter to several millimeters in cubic size. When excited with X-radiation, it acts as an amplifier tube, releasing torrents of electrons that can be used to operate various types of mechanisms.

The crystals amplify the energy they receive 1,000,000 times. On an area-for-area basis they are over 1,000,000 times more sensitive to X-rays than are ionization chambers used to measure X-radiation and over 1,000 times more sensitive than photoelectric cells.

COLD WEATHER BOOT

Development of a new and revolutionary boot for protection against extreme cold has been announced by the Navy Bureau of Supplies and Accounts. The Navy has long sought footwear that insulated without requiring frequent drying, an especially difficult chore aboard submarines and icebreakers where high relative humidity and wet-cold is frequently encountered.

The new boot, originally intended primarily for wear aboard ships in the Arctic or sub-Arctic but now adapted to use ashore or afloat, is rubber inside and out, with wool insulation sandwiched and sealed in as an interlining in the sole, around the foot and ankles, and in the expanding gusset-type tongue. It is worn with only one pair of medium-weight wool-cotton socks, thereby keeping the rubber interlining as close to the skin as possible to prevent excessive perspiration.

The high rate of frostbite cases incurred by Marines in Korea indicated an imperative need for improved cold-weather footwear, with the result that the United States Marine Corps has let a contract for the production of a large quantity of the newly developed Navy boot.

FREE PISTON ENGINE

A revolutionary free-piston power plant which combines conventional Diesel-engine thermal efficiency with the advantages of gas-turbine operation is described in a report available from Office of Technical Services, Department of Commerce. Supplementing previously published information on this French-developed engine, the report deals with the problem of obtaining operating stability, achieved despite the absence of con-rod and crankshaft linkages. The free-piston gas producer is actually a supercharged 2-cycle Diesel producing exhaust gas at 75 p.s.i. pressure and 900-950 degrees Fahrenheit which generates power by expansion to atmospheric pressure in a gas turbine. (Order PB 100 124 "Operating Stability of Floating Piston Gas Generators," $1.75 microfilm, $2.50 photostat, from Library of Congress Publication Board Project.)

IMPROVED INSULATORS

Two improved electrical insulating materials have been developed by the Naval

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NOTE: FOR COMPLETE INFORMATION ON THIS PROCESS SEND FOR BULLETIN FORM 51-3

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Phosphatizing, Rust Proofing and Paint Bonding Chemicals

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
QQ-P-416	"Lithoform"
	"Zinodine"
RR-C-82	"Lithoform" No. 32
MIL-C-5541 (See also QPL-5541-1)	"Alodine"
MIL-S-5002	"Alodine"
	"Granodine" (Dip, Spray and Brush grades)
JAN-C-490, Grade I	"Granodine" (Dip, Spray and Brush grades)
JAN-F-495	"Granodine" (Dip, Spray and Brush grades)
	"Lithoform"
JAN-L-548	"Permadine"
AN-E-19	"Alodine"
	"Zinodine"
AN-F-20	"Alodine"
	"Granodine" (Dip, Spray and Brush grades)
	"Lithoform"
	"Permadine"
	"Thermoil-Granodine"
	"Zinodine"
	(See also U.S.A. 3-213)
U.S.A. 57-0-2	
Type II, Class A	"Thermoil-Granodine"
Type II, Class B	"Permadine"
Type II, Class C	"Granodine" (Dip, Spray and Brush grades)
U.S.A. 51-70-1	
Finish 22.02, Class A	"Thermoil-Granodine"
Finish 22.02, Class B	"Permadine"
Finish 22.02, Class C	"Granodine" (Dip, Spray and Brush grades)
U.S.A. 50-60-1	"Granodine" (Dip, Spray and Brush grades)
U.S. Navord O.S.675	"Alodine"
U.S.N. Appendix 6	"Lithoform"
Navy Aeronautical M-364	"Permadine"
	"Thermoil-Granodine"
AN-C-170	(See MIL-C-5541)
U.S.A. 72-53	(See AN-F-20)
AXS-1245	(See JAN-C-490)

Rust Removing and Metal Conditioning Chemicals

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
JAN-C-490, Grade II	
Type 4	"Deoxidine" Nos. 126, 512, 526, 624, 670
Type 5	"Deoxidine" Nos. 170, 171, 670
U.S.A. 3-213	
Type I	"Deoxidine" (Wash-off grades)
Type II	"Deoxidine" (Wipe-off grades)

Metal Cleaning Chemicals

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
JAN-C-490, Grade II	
Type 2	"Ridoline"
Type 6	"Ridosol"
U.S.A. 3-192	"Ridoline" No. 3192
U.S.N. Appendix 6	"Deoxidine"

Acid Inhibitors, Pickling

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
U.S.N. 51-1-2	"Rodine"

Write us for descriptive folders and further information on the specification chemicals listed above. Additional copies of this chart are available on request.

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New Developments

Research Laboratory: One, a mica paper from low-grade ore and scrap at a saving of high-grade stock, will stand intense heat, is stronger, and has greater capacitance than kraft paper. Its greatest application is expected in electrical condensers. The other is an improved asbestos which forms readily into paper with excellent uniformity and high value as a dielectric. Manufacture involves a wetting process in which centrifugal action removes magnetite or iron-oxide particles.

NEW MINE DETECTOR

An improved mine detector has been developed by the Corps of Engineers which will operate on land and under water. The new detector should prove effective in locating mined areas and expediting the movement of ground troops.

The new mine detectors will locate buried mines in any kind of soil, according to the Army. Older types are useless where magnetite or black earth is prevalent. The Army says the new detector, also able to operate under water, should prove more effective in clearing beach areas. It has been a practice to lay land mines in shallow water near beaches to intercept landing craft and troops.

The presence of a buried mine is indicated to the operator of the new and improved device by a combination of visual and auditory means. The visual meter indicates the presence of a mine, and, simultaneously, its presence is further revealed by a distinct sound in the headset worn by the operator.

TANK ENGINE PLANT

The gigantic Michaud Plant, one of New Orleans' largest industrial sites, will be taken over by the Army for the manufacture of tank engines by the Chrysler Corporation under a 100 million dollar contract. Approximately 6,000 workers will be employed at the plant. The Michaud operation will be a major part of a twin order given Chrysler by the Government. The tanks themselves will be built by Chrysler at a new plant built at Newark, Del. The tank order amounts to 99 million dollars. The tank engines will be assembled at Michaud, under a 100 million dollar assembly contract.

NEW INFLUENZA VIRUS

A new virus strain which affects children and may prove to be another type of influenza has been found in a recent epidemic of acute respiratory disease by the Armed Forces Epidemiological Board. The new strain was discovered during an investigation conducted earlier this year in Michigan by the board's Commission on Influenza, which operates under the auspices of the Army Surgeon General.

The recently discovered virus, which could be called Influenza

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The importance of a completely moisture-proof electrical connector can scarcely be exaggerated. But in addition to this important characteristic, there are a host of other exclusive features that make Bendix Scinflex connectors outstanding for dependable performance. For example, the use of Scinflex dielectric material, an exclusive Bendix development of outstanding stability, increases resistance to flash over and creepage. In temperature extremes, from —67°F. to +275°F. performance is remarkable. Dielectric strength is never less than 300 volts per mil. If you want more for your money in electrical connectors, be sure to specify Bendix Scinflex. Our sales department will be glad to furnish complete information on request.

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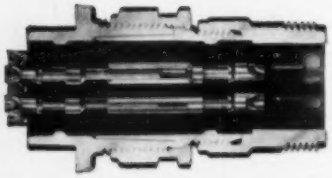

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New Developments

C, was isolated during a mild outbreak of influenza associated with A-prime strains of virus. The epidemic occurred in Michigan last spring. Studies up to the present have disclosed two clear-cut categories of influenza, A and B, as well as some rather pronounced differences between substrains belonging to each of the types.

FORGING PROCESS

A new forging process which eliminates riveted reënforcements in the manufacture of aircraft wing panels has been developed by the Air Matériel Command in conjunction with industry. Specially designed dies and a vertical hydraulic press are used to forge integrally stiffened wing skins ⅛-inch thick, making strengthening unnecessary. Cost of the rivets (as many as 15,000 are used in each surface of a conventionally made wing) is saved as well as the man-hours required to install them. Aluminum loss is almost nil.

POWERFUL HEATER

The first portable ground heater to be powered by a gas turbine engine was recently delivered to the U. S. Air Force by the AiResearch Manufacturing Company of Los Angeles. The result of a rush development-production order placed by the Air Force several months ago, the new heater will produce 4,000,000 B.T.U.'s per hour when the outside temperature is 65 degrees below zero.

RADIATION "DOG TAGS"

Navy researchers have developed two types of radiation "dog tags" which appear to fill the requirements for the protection of its personnel. Both types are simple, rugged, and inexpensive, the Navy said. In addition, these "dosimeters," which measure the amount of radiation exposure the wearer has experienced, keep their sensitivity in storage and under extreme heat.

One type uses salt crystals known as alkali halides, which are normally transparent but turn blue when exposed to gamma rays. Silver-activated phosphate glass is the sensitive element in the other type. Gamma rays convert the glass into a phosphor which takes on an orange color under ultraviolet light.

JET PILOTS' HELMET

U. S. fighter pilots may now bail out at speeds of "more than 500 miles an hour" without fear of head injury or loss of vital oxygen equipment. This important safeguard, particularly for jet pilots, stems from a new plastic visor that virtually glues a crash helmet to a flier's head during high-speed, high-altitude bailouts. The shockproof spherical visor, developed by Bausch & Lomb Optical Company at the request of the Air Matériel Command, is now in production.

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HERE'S one of the most unusual and foolproof fire protection devices ever made.* There are no wires, batteries or bells. Just a whistle attached to a high pressure cylinder filled with CO_2. When the temperature exceeds a pre-set limit, the compressed CO_2 is released into the whistle stem. The piercing blast can be heard for a quarter mile.

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Reliability is only part of the story. There's the economy angle, too . . . Shelby Seamless Tubing has enabled many manufacturers to cut material costs drastically, because the basic shape is already made. You don't end up with half of your steel lying on the floor in the form of scrap. Furthermore, Shelby Seamless Tubing is easy to machine, and its uniform quality permits high speed production.

Let our service engineers work with you to obtain tubing that will fit your needs *exactly.* And make a note to write for Bulletin No. 17. Address National Tube Company, Frick Building, Pittsburgh 19, Pa.

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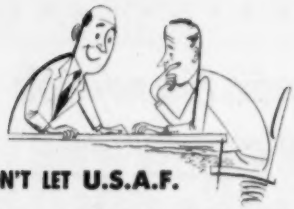

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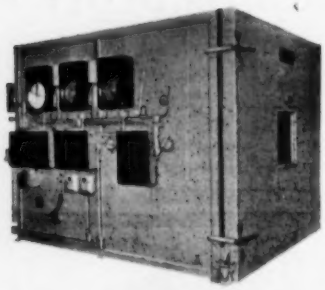

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ATOMIC ENERGY

ORE ANALYSIS MANUAL

The Atomic Energy Commission recently published a new technical booklet describing the analytical procedures for determining the uranium and thorium content of ores. The booklet, entitled "Manual of Analytical Methods for the Determination of Uranium and Thorium in Their Ores," was prepared by the technical staff of the AEC's Analytical Laboratory at New Brunswick, N. J., under the direction of the Raw Materials Operations Office.

The new manual, which is intended principally for chemists and assayers with an understanding of chemical fundamentals, contains a compilation of the methods for the analysis of pitchblende, carnotite-bearing sandstone, shales, phosphate rock, and monazite sands. It was prepared for the particular purpose of assisting and encouraging commercial laboratories, as part of their normal business, to take over gradually the function of making uranium analyses for prospectors and miners. This function is now performed largely by official laboratories of the AEC, U. S. Geological Survey, and Bureau of Mines.

The booklet is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at twenty cents a copy.

DATA DECLASSIFIED

The Governments of the United States, the United Kingdom, and Canada have adopted a revised "Declassification Guide," which will permit the publication of certain information necessary to the design, construction, and operation of specified low-power nuclear reactors used for research purposes.

The action is an outgrowth of the Fourth International Declassification Conference of February 1950 at the British Atomic Energy Research Establishment, Harwell, England. It recommended revisions to the "Declassification Guide" used by the three nations to determine what atomic-energy information held jointly may be published and what information is to remain classified.

Technical information declassifiable under the guide must be reviewed prior to publication in accordance with the declassification procedures in effect in each of the three nations. Details on design, construction, and operation of the newly declassified reactors will be contained in a number of technical papers to be published after clearance through the declassification system. Values of pertinent nuclear constants of uranium, required for work in this field, will be published in a special technical report to be issued by the atomic-energy agencies of the three governments.

The three governments have determined that the release of information under the revised guide will speed the training of nuclear-reactor engineers and technicians and will hasten atomic-energy development in these countries, particularly for peacetime applications. It was determined that this information would not aid rival nations in the development of military applications of atomic energy. Low-power research reactors cannot be used for producing atomic weapons or power.

ATOMIC SUBMARINE

An atomic-powered submarine, of which the first would cost an estimated $40,000,000, or about four times that of present fleet-type submarines, might be capable of greatly extending the operational range while completely submerged and at speeds greater than of surface operation, according to K. A. Kesselring, assistant head of the engineering division of the Knolls Atomic Power Laboratory, Schenectady, N. Y.

Even though the snorkel breathing tube, introduced in World War II, now makes it possible for submarines to remain submerged for far longer periods than formerly, they are still tied to the surface since their Diesel engines must be supplied with air. The atomic submarine, however, could cruise completely submerged for periods limited only by the air requirements of the crew.

It could be designed for underwater cruising as the normal operation, and thus the hull design could be altered to improve its hydraulic characteristics so that, for the same amount of power delivered to the propeller shafts, its submerged speed would be even greater than what it could do at the surface.

In addition, full-speed underwater operation would be possible for extended periods reckoned in days rather than in hours. And since the submerged speed could be enough to bring all surface vessels within its range, the submarine would become a wolf that could go after its prey not, as in the past, a spider that must wait quietly for its victim to approach.

Instead of increasing the amount of machinery, atomic power might reduce it, and the dead weight of atomic fuel for a long cruise would be negligible.

WHY
FRANTZ FERROFILTER

catches ferrous particles as fine as one micron and increases the life of machinery using circulating oils

IN ALL machinery using circulating oil systems, the metal worn off the surfaces becomes mixed with the oil causing abrasive damage to the smooth surfaces of bearings and gears. The abraded metal remains in the oil until removed. Through the FRANTZ permanent magnet FERROFILTER (Magnetic Filtering) steel and iron particles are magnetically extracted from suspension in the oil — *even as small as a micron in size.*

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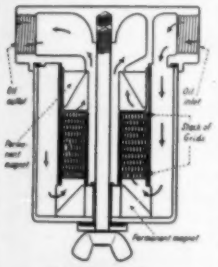

The FRANTZ FERROFILTER is reducing abrasive wear in hundreds of plants, both large and small. There are many types and sizes sure to fill your particular requirements. Send now for our bulletin No. 50 for detailed information.

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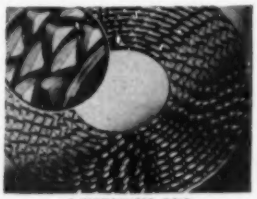

A FERROFILTER GRID
Magnified inset shows particles on collected grid edges.

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The Handy Vari-Speed Governor used on many well-managed truck fleets over a period of years has proved its outstanding value in preventing costly operating practices.

A poll of 180 such fleets shows actual savings as follows:

General maintenance	26%
Engine repair	32%
Tire maintenance	22.6%
Insurance	16%
Lubrication	26%
Fuel	13.5%
Brake maintenance	29.2%
Accidents	37%

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Bowser Walk-In Rooms have a temperature range from +180°F. to —100°F. and relative humidity simulation from 20% to 95%. Because of sectionalized panel construction any size or shape room can be manufactured for final assembly in the field. Smaller sizes are preassembled at the factory. Extended ranges of temperature, humidity and provision for altitude simulation can be provided. Special accessories and instrumentation also available.

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FROM THE RECORD

VEHICLE PRODUCTION

Compare the pre-Korean and last week's budgets. Of $9,600,000,000 voted for the Army last week, $6,500,000,000 is for tanks, motor vehicles, guns, spare parts, and other "hardware." Thus the ratio of such procurement to other items has become more than seventy per cent of the whole as compared with less than fourteen per cent before initiation of the accelerated defense program.

The trend is clear. The impact of the defense program on the automotive industry will be tremendous. Your industry produced more than eight million civilian vehicles in 1950. No contract the Army has let to date will directly put out of production any existing automotive assembly line, but there is no doubt that many companies will soon have cutbacks in civilian production caused both by the need for producing defense items and by the scarcity of raw materials for civilian items.

The Army's plans for the fiscal year 1951 require the spending of more than four billion dollars in the tank-automotive field alone.—UNDER SECRETARY OF THE ARMY ARCHIBALD S. ALEXANDER *before the American Society of Automotive Engineers, Detroit, Mich.*

SOVIET INTENTIONS

Military strength in being can at best provide only a cover for the development of more effective means of waging peace. Without the deterrent to Soviet aggression which a respectable armed force alone can provide we may never have a chance to employ these other means to win the peace. If we fail to close the land-power gap, our best efforts to close the lead-time gap may well be in vain. Our concept must thus be twofold—ready military strength to deter aggression and buy time and an affirmative, coördinated political, economic, and psychosocial program to win the war for men's minds. What does this twofold concept mean in terms of a positive course of action?

Although no American can divine the intricacies and timing of the plans which the masters of Soviet Russia have devised for our destruction, we can arrive at certain obvious conclusions as to their intent and design. High among their immediate objectives must be that of increasing their control over the world's economy and industrial potential. Outside of continental United States itself, the greatest concentration of industrial potential in the world is in Western Europe. If they can secure control of Western European economy without causing its destruction in the process they will have gained years of time in their program for world domination. To secure Western Europe intact, therefore, I think we can axiomatically assume to be their intent.

In these premises it seems fair to assume that were we, in collaboration with the free nations of Western Europe, to develop sufficient military potential in being in those areas as to convince the Soviets, beyond a reasonable doubt, of our intention and determination to fight for every square foot of territory, their military invasion of these countries might never be launched.

Were they convinced that the only reward of, what to them would be a difficult and expensive campaign, would be only the smoking remnants of Western Europe —a scorched earth of impoverished peoples and dislocated economies—it seems extremely doubtful whether these practical realists of the Kremlin would consider such an effort worth the cost. Indeed their record has been consistently to overpower weaker peoples, not to challenge situations of strength.—ASSISTANT SECRETARY OF THE ARMY KARL R. BENDETSEN *before the Railway Business Association, New York, N. Y.*

STRATEGIC AIR POWER

It is apparent that even air power is not the single miracle deterrent that can dispel the danger of war by accomplishing all . . . missions. Indeed, any one who would fear war less for believing that air would win it handily is deceiving himself with an illusion.

Yet in strategic air bombing we do have for the first time a weapon capable of cracking an enemy's will to resist by striking at his home sources of strength. Nevertheless it does not follow that air bombing could deter an enemy bent on the plunder of Europe's resources.

For to defeat an enemy by crushing his home sources of supply it is essential that we prevent him from acquiring new ones. Unless Western Europe is adequately defended, an enemy might overrun its industrial plant and readily supplant its own logistical sources by those acquired through conquest. Thus, were an aggressor to occupy the nations of Western Europe, it would have circumvented the decisiveness of strategic air power in the war.

For that reason the decisiveness of strategic air power is peculiarly dependent upon the ability of ground armies to withstand an aggressor and limit him to his own home sources of supply. And since those ground forces are dependent upon the Navy for their logistical support, air

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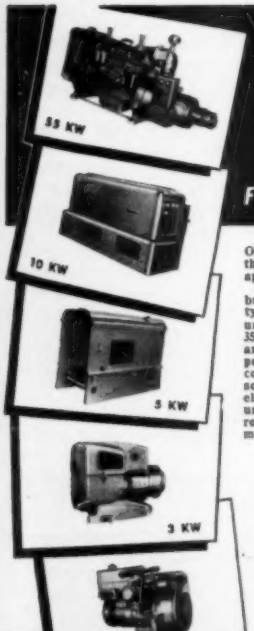

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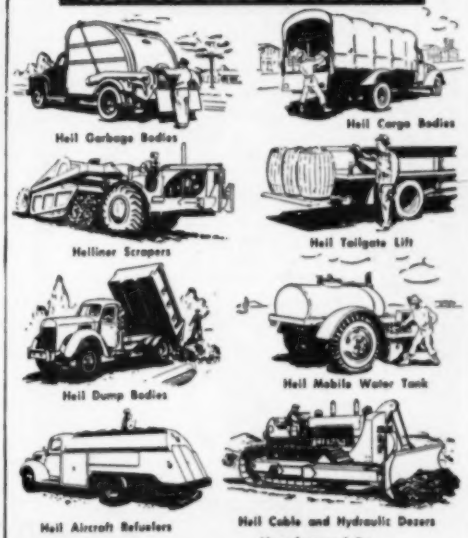

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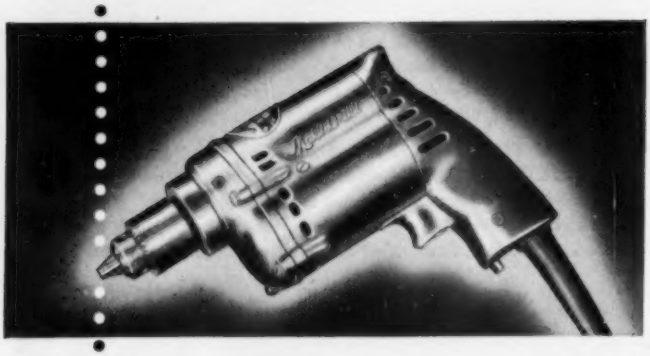

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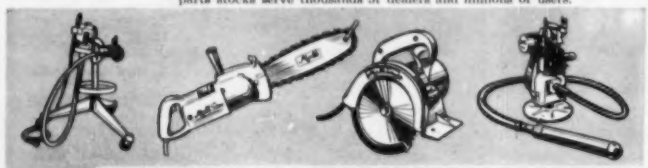

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power becomes no less dependent upon sea power than are the Allied land forces in Europe.

By the same token, both are similarly dependent upon strategic air power. For however speedily we re-create Atlantic community land strength and its supporting sea power, we shall never mobilize manpower to withstand Communist aggression unless air power can demolish the enemy's logistical sources and limit his armies to what they might have accumulated in stock piles.—GEN. HOYT S. VANDENBERG, *Chief of Staff, U. S. Air Force, before the National Association of Radio News Directors, Chicago, Ill.*

ATOMIC ENERGY PROGRAM

Ten years ago there was no atomic energy program in this country. Today we have a program housed in a physical plant in which the capital investment amounts to nearly two and a quarter billion dollars and comprises one of the largest and probably the most complex systems of laboratories, manufacturing plants, and test facilities in the entire world.

Geographically these facilities extend from the Brookhaven National Laboratory on Long Island to the Radiation Laboratory at Berkeley on the Pacific Coast and on out to the remote weapons test site at Eniwetok Atoll in the Marshall Islands. The lines of supply for these plants and laboratories reach to such distant regions as the Belgian Congo and the Canadian Arctic.

In size, the facilities range from small suites of offices in such cities as Boston, Cleveland, and Denver to the 400,000-acre plutonium production works at Hanford, Wash., and the 440,000-acre reactor test station in Idaho.

The total land area occupied by the installations owned by the Atomic Energy Commission comprises some 2,800 square miles—an area almost equal in size to the states of Delaware and Rhode Island combined. These holdings are located in nineteen States and include Eniwetok Atoll in the Pacific Ocean.

To man this vast system of plants and laboratories the atomic-energy program now employs some 70,000 people. About 5,000 work directly for the Commission and 65,000 for the industrial concerns and educational institutions that operate the production and research facilities under Government contract. By fall of this year this total number will increase to very nearly 100,000. Subcontractors and suppliers that perform work related to the program are numbered in the thousands.—T. KEITH GLENNAN, *U. S. Atomic Energy Commission, before alumni of Stevens Institute of Technology, New York, N. Y.*

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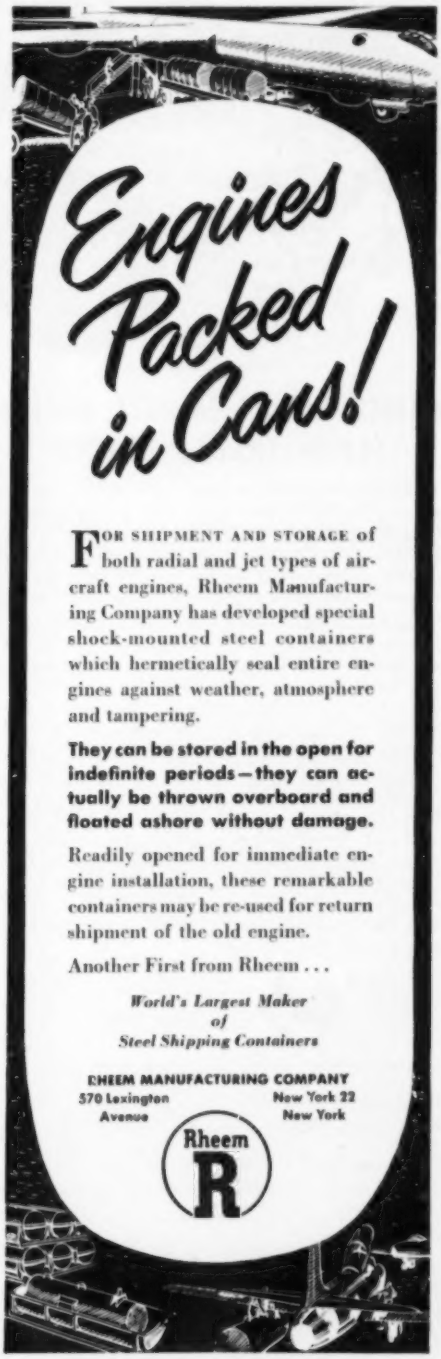

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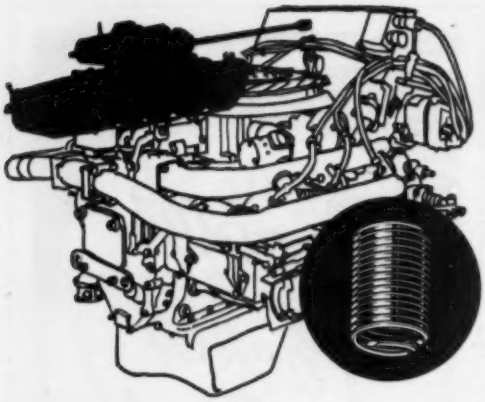

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Chief of Staff: Prewar Plans and Preparations. By Mark S. Watson. Washington: Government Printing Office. 520 pp. $3.75.

THE vantage point from which the American people control and operate the machinery of war—the Office of the Chief of Staff, U. S. Army—is the subject of an official history written by Pulitzer Prize winner Mark S. Watson and published by the Department of the Army.

How decisively public opinion affects the size of the Army and its degree of preparedness is revealed by the close examination of what goes on in the Office of the Chief of Staff, as pictured by this volume. For although the Army works out plans for emergencies, the author points out, it is the public pulse which in the final analysis gives Congress and the White House the stimulus to "provide" for the common defense.

In the light of current events, Mr. Watson's recital of the complex problems faced by the Army—and especially by the Chief of Staff—in the years preceding World War II has astonishing applicability today.

Like other volumes in the series on "The U. S. Army in World War II," of which this is the sixth, "Chief of Staff: Prewar Plans and Preparations" is a scholarly and objective work and launches a 9-volume history of the War Department. Other volumes in this subseries will deal with the Secretary of War, the Chief of Staff's office during the war years, and with the divisions of the War Department General Staff.—ROBERT EMSWORTH.

The Effects of Atomic Weapons. Prepared by the Atomic Energy Commission and the Department of National Defense. Washington: Combat Forces Press. 438 pp. $3.

How To Survive an Atomic Bomb. By Richard Gerstell. Washington: Combat Forces Press. 148 pp. $1.95 (boards).

How To Survive an Atomic Bomb. By Richard Gerstell. New York: Bantam Books. 146 pp. $1.25 (paperbound).

THESE three books are versions of the same thesis. "The Effects of Atomic Weapons" is a comprehensive and fairly

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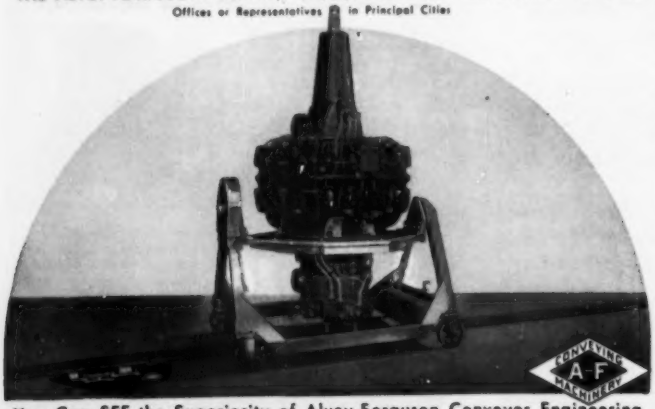

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complete study issued under the direction of the Civilian Mobilization Office. It has the commendation of the National Security Resources Board and is recommended as a source of scientific information for technical personnel engaged in civil-defense planning activities. It contains detailed descriptions of the physical phenomena associated with atomic explosions and provides certain basic data helpful in the preparation of practical plans for atomic warfare defenses.

This book is the last word from authoritative sources on what the civilian and civilian organizations should know and be prepared to do when confronted with the effects of atomic weapons.

The other two books are in the same condensed catachetical text although their form of presentation is different. But both are handy pocket volumes containing the pertinent questions and answers with which every one should be familiar. Either of the two volumes, or both for that matter, should have widest circulation among all groups of American citizens so that in the event of an atomic attack ignorance of what to do will not add immeasurably to the degree of destruction and suffering which will follow.

Under present world conditions it is an obligation of citizenship to know how to behave should atomic bombs be used against civilian populations—which God forbid. Such use—of any kind of bombs for that matter—is morally wrong. But having made the bed we must now be ready to lie in it—and hope to get up again!—Leo A. Codd.

Theory of the Interior Ballistics of Guns. By Dr. J. Corner. New York: John Wiley & Sons, Inc. 443 pp. $8.

THE interior ballistics of guns has long been a rather empirical subject because it has been so difficult to make fundamental experimental studies of the processes involved when a gun is fired. Thus there have arisen various "systems" of interior ballistics for predicting velocities and pressures, which work well enough for moderate velocities when the systems are properly calibrated by firings.

The modern trend toward guns of higher velocity and toward such special types as recoilless and tapered-bore guns makes it less likely that one can continue to use the present systems without important changes. Among the changes that will probably be necessary are improvements in the treatment of gas flow and heat loss.

It is just in such matters, the preparation of readers for serious research in these modern aspects of the subject, that Dr. Corner's book will probably be of

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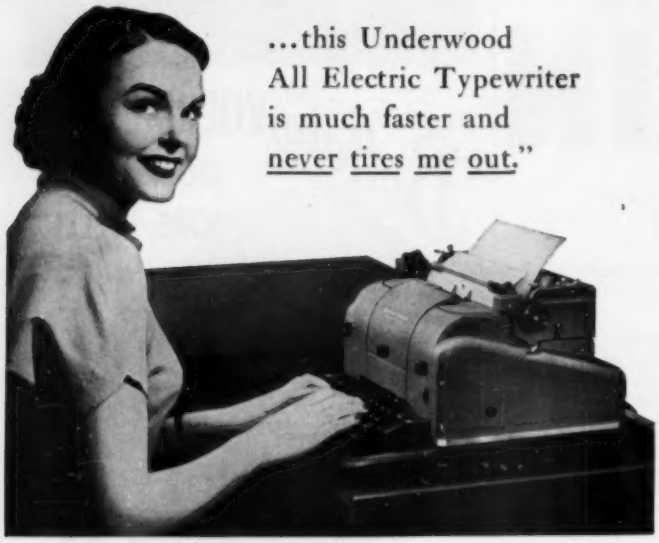

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great value and interest for most readers. He gives clear and authoritative treatments of the fluid-mechanical, thermodynamical, and chemical-kinetic aspects of the subject. He also gives a number of treatments, on various levels of approximation, of the central problem of the subject: Given the gun, the projectile, and the powder charge, to calculate powder pressure and projectile velocity versus time or projectile travel.

This book is the only up-to-date presentation of interior ballistics in open publication and can be recommended as thorough, sound, and penetrating.—JOHN P. VINTI.

How To Be a Crack Shot. By Claude Parmelee. New York: Greenberg. 78 pp. $2.50.

THIS is an excellent, brief, well-illustrated introduction to the essentials of rifle and shotgun shooting. The author is an authority on trick aërial shooting, and the book is rich in action photos and diagrams showing Mr. Parmelee in action.

Aërial shooting is especially interesting, and Mr. Parmelee of course demonstrates his own personal techniques. Thus he throws up tin cans with the left hand, right hand on the pistol grip. Some shooters, especially when using heavier weapons than a .22, prefer to hold the piece with the left hand at the balance, throwing with the right hand. Actually the throwing of the target is over half the problem.

The reviewer heartily agrees with the author's insistence that careful sight adjustments and practice are essential to success and clean sport. This book is heartily recommended.—M. M. JOHNSON, JR.

Uniform Code of Military Justice. By Col. Frederick Bernays Wiener. Washington: Combat Forces Press. 271 pp. $3.50.

COLONEL WIENER has written with telling effect in recent years on various phases of military justice. In 1940 he presented his "Manual of Martial Law." Three years later his volume, "Military Justice for the Field Soldier," was published. In 1948 he introduced "The New Articles of War" and in 1950 his book on "Effectiveness of Appeals in Military Courts."

Now he offers in the "Uniform Code of Military Justice" an explanatory and comparative text and commentary on the new code which, on May 31, 1951, will be adopted by our Army, Navy, and Air Force. On that date the articles of war will be discarded.

In this concise volume are many of the answers to the basic questions which extend to a new uniform code of mili-

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tary justice. For one thing, the complete comments and explanations of the Congressional committees which study the code are of prime importance for they are indicative of the intent of the legislators. Reference to the legislative history and comments of the drafting committee of the Department of Defense are likewise most important.

It is hard to visualize how any one subject to or in any way concerned with military law can get along without this most timely book.—Leo A. Codd.

Military Management for National Defense. By Col. John Robert Beishline. New York: Prentice-Hall, Inc. 276 pp. $5.

THE author of this study has devoted a great deal of his lifework to the improvement of the operations of our military machine. He was graduated from the United States Military Academy, receiving his master of arts degree from Columbia University and his Ph.D. in industrial management from Ohio State University. He is now assigned to the Office of the Chief of Staff, Department of the Army, as executive to the Deputy Chief of Staff for Administration.

The book is represented as a scientific blueprint for maximum effectiveness and economy based on the most successful practices of American business management and the best traditions of military organization. The text is all that it is claimed to be—and more. The author is to be congratulated on the thoroughness of his analysis and the timeliness of its presentation.—O. E. D.

Target Shooting Today. By Capt. Paul B. Weston. New York: Greenberg. 81 pp. $2.

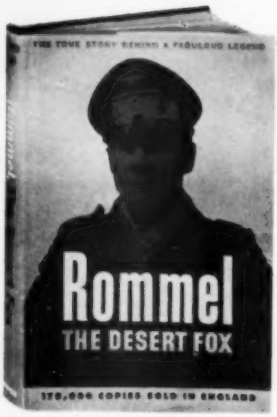
PERHAPS the most surprising of the ordnance stories that have emerged from the Korean fighting is the significant increase in the evaluation of the pistol. Fighting men have believed in this weapon for many years, but it *does* take some extra work to master the effective use of the one-hand gun. "Target Shooting Today" offers an effective and very concise answer to the problem.

The author has spent many years of coaching individual and team shooters, including the Marines and the New York police. The techniques which Captain Weston has developed in training thousands to hit with the revolver are really new and deal with the fundamentals rather than the refinements of shooting.

A splendid bibliography of nearly a hundred titles points the way to further study in any phase of shooting.—F. W. Foster Gleason.

AMERICAN ORDNANCE ASSOCIATION

Book of the Month for MARCH



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the DESERT FOX

BY BRIGADIER DESMOND YOUNG

Erwin Rommel was a legend in his own lifetime. His vivid biography is a splendid evaluation of both the soldier and the man. Brigadier Young (once Rommel's prisoner) bases his work on data obtained from Rommel's family, from men who served under him, from firsthand experience, and from recently discovered personal papers. A brilliant objective biography of the man Winston Churchill called, "Across the havoc of war, a great general."

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RED MASQUERADE (UNDERCOVER FOR THE FBI)

BY ANGELA CALOMIRIS

The authentic inside story of the Communist Party in the United States by one who posed as a party member while acting for the FBI. Here is how the party operates—its techniques, its members. Here, in fact, is a handbook of Communist activities on a practical level, by a courageous and intelligent young woman. Retail, $3.00

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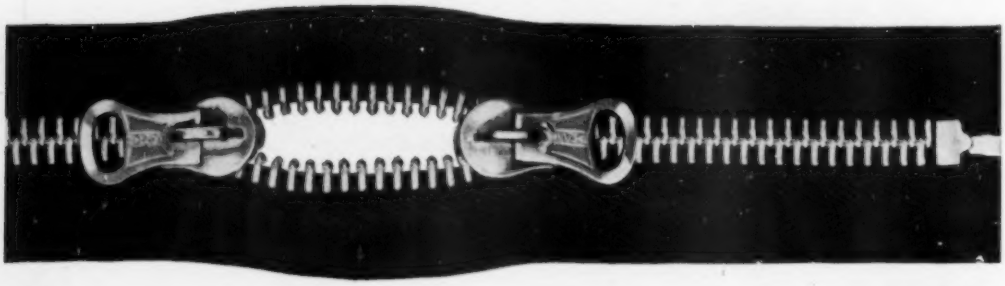

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Quonsets give you more than speed. You get maximum economy of material, all-steel fire safety, adaptability, construction ease, and the durability of N-A-X alloy steel.

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GREAT LAKES STEEL CORPORATION
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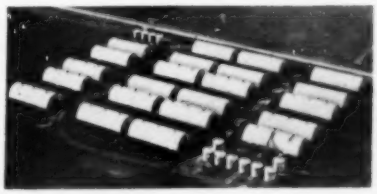
. . . and smaller ones, too!

◊ The Arco Company, producer of industrial paint, needed maximum fire safety for its lacquer manufacturing division at Cleveland. It chose Quonset buildings, centering production in the Quonset 40x80 in foreground. Nitrocellulose and other combustibles are stored in nearby smaller Quonsets.



An example of Quonset speed

◊ **88,000 SQUARE FEET OF STORAGE SPACE COMPLETELY BUILT IN ONLY 45 DAYS** —This grain storage depot at Beresford, S.D., was part of last fall's Department of Agriculture program. More than 2,500 Quonsets were erected at 803 different midwestern locations, providing storage space for over 80 million bushels.

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- Wire Pointers
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The Aetna-Standard Engineering Company

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Both Sweeps and Mops

You save time and cut costs with this dual-purpose cleaning tool. It sweeps and dusts at the same time. Fully washable. Zipper opening does away with troublesome tape ties. Fuller Standard 4-ply cotton yarn, securely stitched to sanforized canvas backing, picks up and holds the dust. In sizes 12", 18", 24", 30", 36", 42", and 48" wide.

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Using "HYGROL" Absorbent Liquid

Because it absorbs moisture from the air directly, the new Niagara Controlled Humidity Method uses less, or no, mechanical refrigeration for dehumidifying. You save first costs and installing of heavy machinery. You save space, maintenance expense, power; get easier, more convenient operation.

Using "Hygrol" absorbent liquid gives complete control of temperature and relative humidity. Especially, it is a better way to obtain dry air for drying processes, packaging hygroscopic materials, preventing moisture damage to metals, and obtaining better quality for chemical process and food products—or in obtaining better results in comfort air conditioning at lower refrigeration costs.

Filtered air is dehumidified by passing through a spray of "Hygrol" which removes airborne moisture. This liquid is non-corrosive; it contains no salts or solids to precipitate and cause maintenance troubles. It is continuously re-concentrated at the same rate at which it absorbs moisture, providing always the full capacity of the air conditioner, automatically.

Food Packaging under Controlled Humidity

Units provide a range of capacities from 1000 to 20,000 C. F. M. Multiple unit installations are in use successfully. Records of results are available. For further information, write **Niagara Blower Co., Dept. O, 405 Lexington Ave., New York 17, New York.**

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. . . 300,000 square feet of manufacturing area devoted entirely to the production of ★ Aluminum Permanent Mold Castings ★ Aluminum Die Castings ★ Zinc Die Castings.

. . . Monarch pioneered in the development of aluminum permanent mold castings and today offers the most modern permanent mold production methods.

. . . Monarch also offers a modern die casting division devoted exclusively to precision casting of aluminum and zinc.

. . . Monarch coordinates the production of both permanent mold and die castings under the supervision of two completely staffed engineering departments to assure sound, economical casting design.

. . . Monarch uses complete physical and metallurgical laboratory facilities to maintain highest quality control methods and inspection standards.

. . . Monarch services include finishing and assembly operations for individual permanent mold and die castings or complete product assembly.

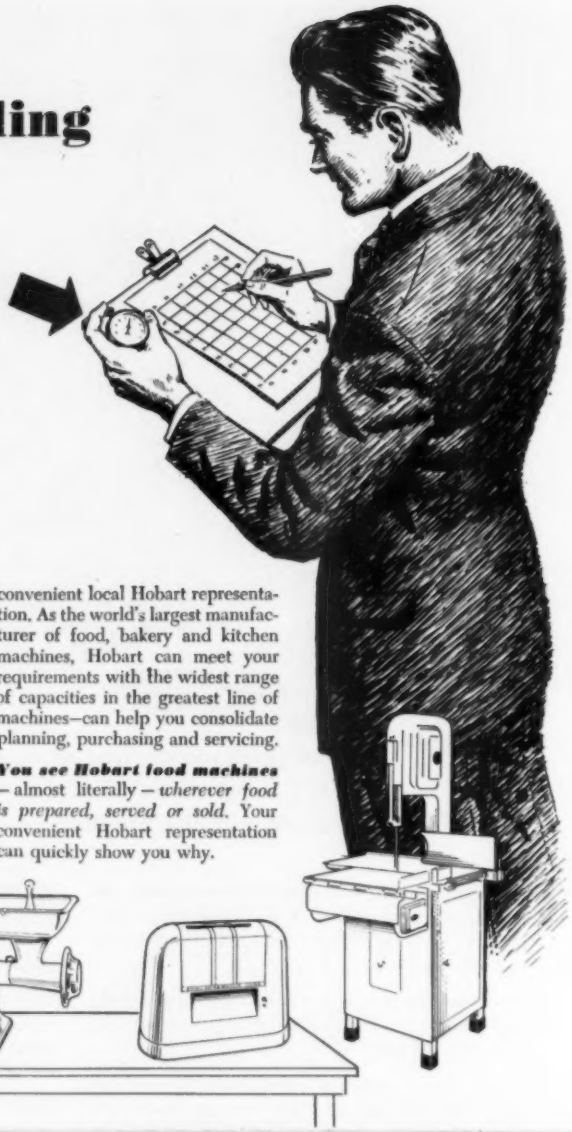
. . . Monarch offers modern, company-owned toolroom, maintenance and warehousing facilities within a plant that is strategically located for rail, air or truck shipment.

Here at Monarch we welcome the opportunity to work with you in giving the widest possible casting service, utilizing the full scope of our unique casting facilities.

NOTE: This advertisement forms the nucleus of an interesting folder giving the complete story of Monarch's facilities. We will forward this folder upon request.

MONARCH ALUMINUM MFG. COMPANY • *Detroit Avenue at W. 93rd Street • Cleveland 2, Ohio*

Look at Quantity Feeding *this* way!



Why tolerate production methods in a mess-kitchen or galley that wouldn't be allowed for an instant in an efficient plant? Why put up with the high cost and low output of wasteful hand methods—or of inefficient food machinery?

Look at it this way: your finished product is a healthy, balanced meal, quickly served in pleasant surroundings—an increasingly important industrial and military asset. Your raw materials consist of meat, eggs, vegetables, cereals, beverages—in quantity. Efficient production calls for flow and methods based on dependable, high-output, trouble-free food and kitchen machines. Literally, without such machines as *built by Hobart*, quantity feeding today would be economically impractical.

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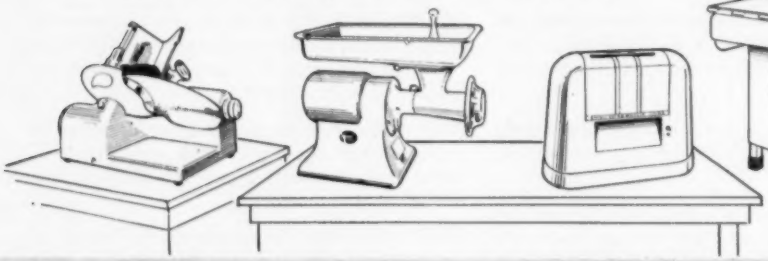
You see Hobart food machines — almost literally — *wherever food is prepared, served or sold.* Your convenient Hobart representation can quickly show you why.



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Hobart *Food Machines*

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These low-alloy, high-tensile steels do "make a ton of sheet steel go farther"—for their inherently higher strength is 50% greater than mild carbon steel. That means, in turn, that 25% less section can be used with safety, and where rigidity is important, this can usually be compensated for through slight design change.

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Explore the potential economies to be derived from the use of low-alloy, high-strength steels—and then specify them. Their use can add materially to our national conservation program.

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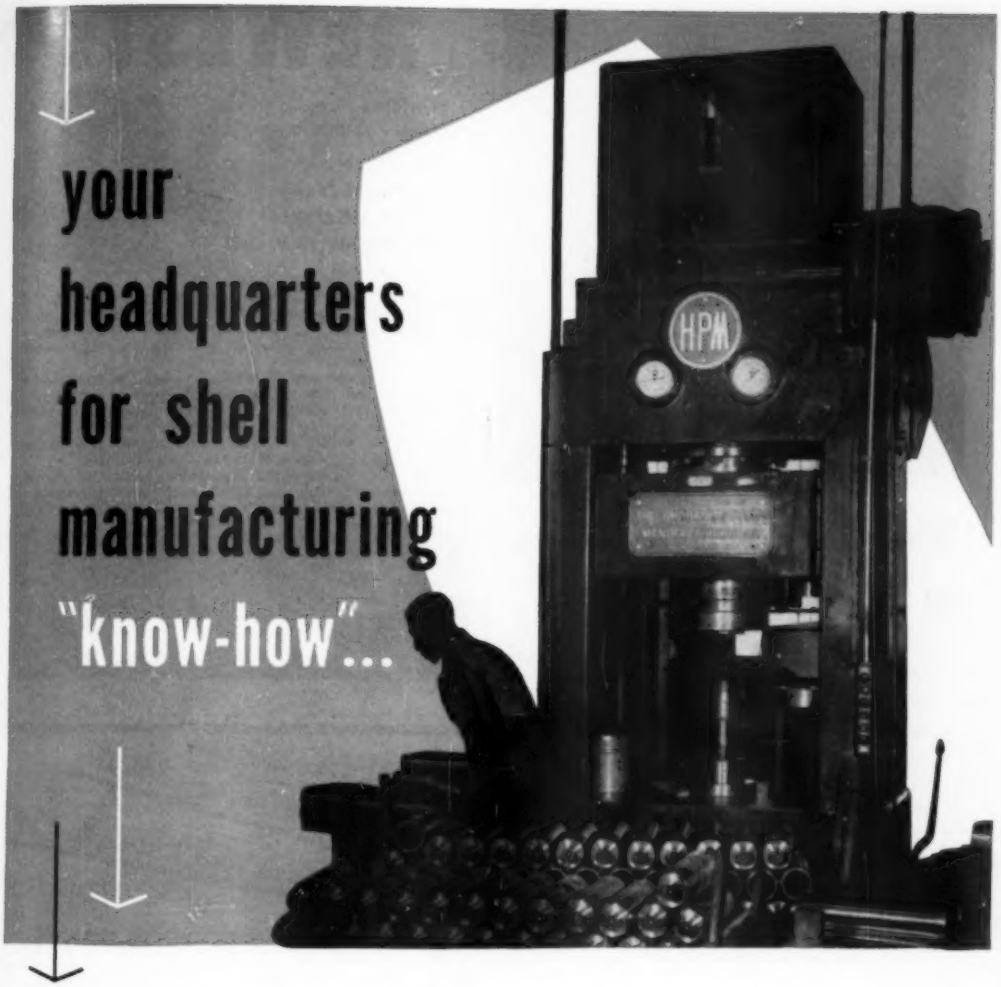

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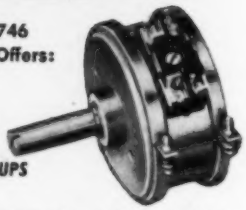

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ROSS HEAT TREATING and AGING OVENS have long been recognized as outstanding in quality and performance. Their record during World War II in the production of aluminum and magnesium castings for aircraft engines and similar equipment recommends them for all heat treating and aging requirements. Write us for descriptive data.

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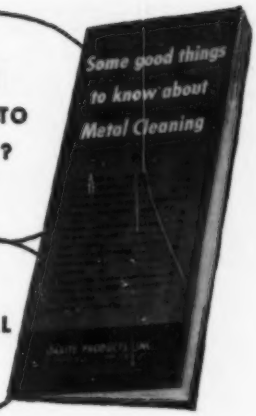
ATLAS
POWDER COMPANY
Wilmington, Delaware

WHAT'S THE FASTEST WAY TO CLEAN METAL?
See page 11

WHAT'S THE MOST ECONOMICAL WAY?
See page 9



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"Some good things to know about Metal Cleaning"

answers many questions that mean better production for you, more money in your pocket. You'll want to read more about:

Can one cleaning material do all metal-cleaning jobs? *See page 5.*

What kind of cleaner attracts both oil and water? How does this help remove buffing compound residues and pigmented drawing compounds? *See page 8.*

What are the advantages of reverse current for electrocleaning steel? *See page 15.*

Can you electroclean brass without tarnishing? *See page 18.*

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Would you like a cleaner that removes rust and oil in one operation, often eliminating all need for pickling? *See page 28.*

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OAKITE
MATERIALS • METHODS • SERVICE
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TOP-MOST PICTURE STEADINESS
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The New FASTAX 8mm camera has a speed range from 300 to 14,000 pictures per second. The New FASTAX 16mm camera has a speed range from 150 to 7,000 pictures per second. The New FASTAX 35mm camera has a speed range from 500 to 5,000 pictures per second. Only with the FASTAX are such wide speed ranges obtainable.

The New FASTAX Camera Optics produce high resolution. The Wollensak name is your assurance of the finest in optical performance.

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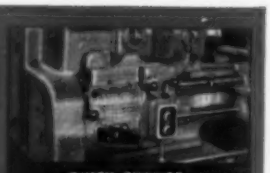

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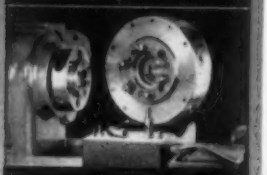

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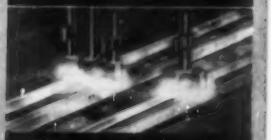

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

WRONG TARGET

A Study of the Use of Strategic Air Power in World War II

Col. S. R. Shaw, U.S.M.C.

Shore Party Officer, Division of Plans and Policies, Headquarters, United States Marine Corps

THE Allied strategic air forces were misused in the Second World War. The manner of their use violated five of the generally accepted principles of war—those of objective, mobility, mass, coördination, and economy of force. Moreover, the major usage of Allied strategic air forces was not only a merely incidental contribution to the actual victory, but it was of such a nature that it materially disrupted the means of assuring a solid and lasting peace.

Such a statement as that above, so different from the commonly accepted version, requires proof of the most convincing sort. That proof is contained in the voluminous reports of the U. S. Strategic Bombing Survey. It is true that the published reports do not directly state such conclusions. However, a fair and objective study of the facts and figures related in the approved reports of the Survey show that the conclusions are supported by overwhelming evidence.

Survey Described

For those who are not familiar with the Survey and the remarkable work that it did, the following is a brief description:

It was established in 1944 by order of President Roosevelt. Its principal purpose was "to establish a basis for evaluating air power as an instrument of military strategy by an impartial, expert study." Its directors were a group of able and practical American citizens of noteworthy caliber. Franklin D'Olier, on leave as president of the Prudential Life Insurance Company, served as chairman.

Working directly under the directors were 300 civilian engineers, scientists, economists, and industrial experts. The services provided 350 officers and 500 enlisted men. They had complete access to all American and British information.

They followed the advancing Allied armies closely, scouring Germany for its war records. They closely examined several hundred German plants and interrogated thousands of Germans, including the surviving leaders. The same group followed the same procedures for Japan.

For the European war over 200 separate reports were published. For the Pacific war there were over 100 reports. They developed a punched-card, electric tabulating system for statistical information that has over two million cards in its files. The various reports of the Strategic Bombing Survey and their supporting documents are a unique achievement in attempting to record and report accurately on one aspect of the Second World War.

Since it is axiomatic that any thinking individual would require full substantiation of such statements, I have troubled the printer by footnotes indicating the exact sources of the evidence. Fortunately it is all in unclassified form, though unfortunately it is not all readily available to the general public or even to the bulk of the officers of the armed forces.

However the sources should be available in the official repositories on the distribution list of the Government Printing Office. Such quotations and condensations as appear here are in context. Italics are the author's.

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The first period of the European use of strategic air forces consisted of the solitary effort of the British Royal Air Force from 1940 until late 1942, and from then until June 1943 jointly by the R.A.F. and the United States Army Air Forces. Initially the main R.A.F. targets were oil, aluminum, and airplane-engine plants, with marshaling yards as secondary targets for the frequent occasions when primary targets were not found. However, accuracy was so poor that the campaign was changed to one of area bombing of cities. It was thought that the destruction of cities would lead to the destruction of German morale. The efforts of the U.S. A.A.F. were directed against submarine bases and yards.[1]

Policy Inaugurated

The January 1943 Casablanca Conference resulted in a directive which inaugurated the efforts of the strategic air forces to demonstrate the validity of the theories of Douhet and other advocates of the ability of strategic air attack to defeat the enemy by the destruction of the hostile economic potential in general and his industrial plants in particular.

The primary objective was stated as "the progressive destruction and dislocation of the German military, industrial, and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened."

Priority of targets was named in order as submarine yards, aircraft plants, transportation, oil, and other targets in German industry. This wide selection was further widened by qualifications to the point that the Survey states:

"It is clear from the above that the Casablanca Conference intended to give the maximum freedom to the commanders of the air forces to act according to their own judgment."[2]

That this judgment was freely used is shown by the 1943 statistics of bomb tonnage dropped upon the priority targets until June 1943 when a new directive was issued. Of almost 82,000 tons, only 2,594 tons, or 3.2 per cent were aimed at the first priority, submarine yards; 1.9 per cent at aircraft plants, the second priority; 3.6 per cent at the third priority, transportation (most of this came from failing to locate the original raid objective). However other targets received 22.1 per cent, and the no-priority area targets were blasted with 56,569 tons or 69.4 per cent.[3]

A New Directive

In June 1943 the Combined Chiefs of Staff issued a new directive making enemy fighter aircraft strength (as represented by both factories and the operational units) a first-priority target, followed by submarine yards, other aircraft industry, ball bearings, and oil as further primary targets, and synthetic-rubber, tire, and motor-vehicle plants as secondary targets.

The new assignment was notable in that it recognized the necessity of establishing air supremacy by destruction of enemy fighter strength and by the attempt to destroy plants whose loss might affect enemy front-line strength fairly quickly.[4]

The concentration upon destruction of enemy aërial defenses is most notable as it was a recognition of one of the fallacies in the theories of Douhet and his followers—that heavily armed bombers in close formations could successfully break through enemy defenses.[5]

The second consideration was even more notable in that it selected, as the most suitable means of quickly affecting enemy front-line strength, targets that were, for the most part, so remote that they could not be attacked successfully until the first consideration had been met. And the first consideration could not be met until the introduction, in 1944, of long-range escort fighters.

"The tremendous expenditure of planes, men, and gasoline in order to drop one and a half million tons of bombs on German industry was misdirected. Far from destroying the enemy's morale and reducing his war production it spurred him on to ever-higher levels of production."

The June 1943 plan was followed until July 1944. During the period, at the request of the ground forces, some "diversion" of effort was made to support the coming invasion by attacking the French and Belgian railway systems.

The effort, approximately one-fifth of bomb tonnage dropped in the period, was largely concentrated in the second quarter of 1944 when 107,208 tons, three times the amount used against all transport in the entire war up to then, was aimed at French and Belgian rail systems.

Following this period, the attack against German industry was resumed, with oil plants as a priority target, a June 8th directive stating that "the primary strategic aim of the U.S. Strategic Air Forces is now to deny oil to enemy armed forces."

This effort commenced in May 1944 and continued until March 1945, 135 different targets within the oil-production industry receiving 193,000 tons of bombs. However, again the attacks against cities and other industries were increased.

As a result of "diversions" to support the ground forces, the last quarter of 1944 and the war months of 1945 showed a spectacular increase of effort against transportation, to a total for the period of one-third of the tonnage.[6]

This too-brief résumé of the use of strategic air shows that the primary aim of those forces was to attempt to knock Germany out of the war by an independent use of the air weapon. Winston Churchill, in May 1943, stated it thus:

"Opinion is divided as to whether the use of air power could by itself bring about the collapse in Germany and Italy. The experiment is well worth trying as long as other measures are not excluded."

Extent of Experiment

The extent of this experiment is indicated by the fact that over two-thirds of the strategic effort was aimed at industrial targets. The only reason it was not considerably greater was that on frequent occasions, prior to the mid-1944 introduction of "blind" bombing techniques, the bombers could not find their primary industrial targets and so jettisoned their bombs. This jettisoning usually was aimed at transportation targets and served to build up to a little less than one-third of the total effort

[1] "The Effect of Strategic Bombing on the German Economy," pp. 1-2, hereinafter cited as ESBGE.
[2] *Id.*, pp. 2, 3, 5.
[3] *Id.*, p. 3.
[4] *Ibid.*
[5] Summary Report, p. 6.
[6] ESBGE, pp. 4-5.

what would otherwise have been a smaller percentage.

The tremendous expenditure of planes, men, and gasoline in order to drop one and a half million tons of bombs on German industry was misdirected. Far from destroying the enemy's morale and reducing his war production, it spurred him on to ever-higher levels of production. As our bomb tonnages increased, from 1942 on, so did his industrial output. The reports of the Survey are conclusive:

"Within 2½ years [the period of the increasing air attack against industry] Germany's military output in aircraft weapons and ammunition was raised more than threefold, in tanks nearly sixfold."[7]

A Main Target

The German submarine program was the target of the first systematic air attack and formed the main target of the U.S.A.A.F. during the first six months of 1943. "The effect on output was negligible; the actual production of submarines was up to schedule throughout the period. . . . The output was well maintained until the end of 1944."[8]

"During the first half of 1944 the attacks on aircraft were resumed on twelve times the scale of the 1943 attacks and were directed primarily at assembly plants. Notwithstanding the heavy weight of these attacks, aircraft production doubled from December 1943 to July 1944."[9]

"As to the effects of bomb damage on the civilian economy, there is no evidence that shortages of civilian goods ever reached a point where the German authorities were forced to transfer resources from war production in order to prevent disintegration on the home front."[10]

The attacks against the German people were a failure, for, the Survey states, "their morale, their belief in ultimate victory or satisfactory compromise and their confidence in their leaders declined, but they continued to work efficiently as long as the physical means of production remained."[11]

The Survey states in other places that the industrial facilities remained adequate to the end.

[7] *Id.*, p. 7.
[8] *Id.*, p. 146.
[9] *Ibid.*
[10] *Id.*, p. 13.
[11] Summary Report, p. 16.

"During the first half of 1944 the attacks on aircraft were resumed on twelve times the scale of the 1943 attacks and were directed primarily at assembly plants. Notwithstanding the heavy weight of these attacks, aircraft production doubled from December 1943 to July 1944."

The actual effect of the attack on industry is clear. New all-time production highs were achieved as more bombs were dropped. Total armament production in 1942 rose 40 per cent over 1941; 1943 production rose 60 per cent over 1942. And as the bombs reached a crashing crescendo in 1944, munition output rose 25 per cent more than in 1943.[12]

Even the attacks on specific industries were failures. Of the efforts against ball bearings the Survey says: "There is no evidence that the attacks on the ball-bearing industry had any measurable effect on essential war production."[13] After 2½ years of attack, the German aircraft industry in 1944 produced 2½ times as many planes as it did in 1942."[14]

There was more individual success in destruction of targets in the oil industry, but even there the return on the effort required is debatable. The famed August 1943 attack on Ploesti was a conspicuous failure.

The Survey states: "Monthly deliveries from that source, beginning in September 1943 and continuing until April 1944 were actually greater than they had been before the attack."[15] To keep *one* synthetic oil plant, Leuna, out of production "a total of 6,552 bomber sorties were flown against the plant, 18,328 tons of bombs were dropped, and an entire year was required."[16]

Production Increased

Other attacks against machine-tool plants, electrical equipment, and a large number of civilian industries did not prevent concurrent increases in German production.

The fact that the Allied use of strategic air forces was accompanied by an increase, and not a collapse, of German war production could be further documented by an almost endless series of quotations from the reports of the Strategic Bombing Survey. However the fact remains that German war production finally did collapse. What caused that collapse?

The answer is very simple. The beginning of so-called tactical coördination with the ground forces caused unparalleled strategic successes against the German economy. The ground forces requested the "diversion" of some Strategic Air Force effort against the German transportation system. Commencing in September and October 1944, the "diversion" was granted, and at once the German economy began to disintegrate.

Reports Conclusive

Here again the reports of the Survey are conclusive, as well as more revealing. The Survey says:

"The attack on transportation was the decisive blow that completely disorganized the German economy."[17]

"After D-Day the tactical requirements of the ground forces continued to divert the strategic air forces until the very end of the war; and, paradoxically enough, it was in the course of such diversion that some of the greatest strategic successes of the war were achieved."[18]

"Transport proved to be the weakest link in the logistic chain; its failure was the immediate cause of the breakdown of the supply system and consequently was a decisive factor in the collapse of the German Army."[19]

Since the dawn of organized warfare the enemy's communication lines have been recognized as his most sensitive element. It has long been axiomatic that an industrial nation is held together by its transport system. In the United States, and even more so in Germany, it is well known that the railroad is the strategic ligament knotting together the industrial body as well as being the sensitive motor nerves whose severing causes paralysis.

Think back a moment to the rail strike of 1946, when, as *Time* reported, the effects were felt within forty-eight hours as far apart as Canada and Mex-

[12] ESBGE, p. 140.
[13] Summary Report, p. 6.
[14] *Id.*, p. 8.
[15] "The Impact of the Allied Air Effort on German Logistics," p. 7, hereinafter cited as IAAEGL.
[16] Summary Report, p. 9.
[17] *Id.*, p. 9.
[18] "The Effect of Strategic Bombing on the German War Economy," p. 1, hereinafter cited as ESBGWE.
[19] IAAEGL, p. 5

ico, and at once we began to have unemployment, with entire industries preparing for complete shutdown. Or recall that the interdiction of only six railroad bridges over the Susquehanna would force all through traffic of the Atlantic seaboard to detour to the west of the Alleghenies; that the interdiction of fifty selected railroad bridges would paralyze our entire country.

The United States first introduced the use of railroads, and their seizures, as primary tools of strategy. Control of global transportation through sea power has been the cornerstone of England's empire. Transportation was indeed a factor which these two nations had always exploited in peace and in war. It is strange to reflect that their large-scale introduction of aircraft as carriers of explosives and guns against an enemy nation should have been accompanied by neglect in conducting a strategic attack upon hostile transportation.

The statistical graphs of the Survey are striking confirmation of both the fact that German industry increased its output under the spur of air attack and that it commenced immediate disintegration when the so-called "diversions" for long-range tactical support of the ground forces resulted in the disruption of transport, with consequent collapse of industrial and military Germany. Figure 1 is a composite of the Survey's charts, and though not to the same scales, faithfully reproduces the effects shown in the originals.[20]

The Survey reports also state the considerations that led to the discard of what was proved, both by prior history and the event itself, to be the most remunerative target for gaining immediate paralysis of the enemy economic system and of his military forces:

"Task Too Large"

"It was fully realized that transportation was a strategic target system of great potentialities, but the task was considered too large and the time too short for engaging in an operation that promised only a distant return."[21] "Transportation was not singled out for priority attack as a strategic target system because of its size and complexity and the limited capabilities of the air forces."[22]

The belief that the transportation attack "promised only a distant return" caused the selection of targets against which 2½ years of attack resulted in a threefold increase of production. Included in such targets were those such as the Leuna oil plant "the most dangerous and difficult assignment of the air war,"[23] which was attacked for an entire year with a cumulative total of more than 6,500 bombers which dropped more than 18,000 tons of bombs.

The Survey states that "a combined target system designed to paralyze the basic traffic to and from the Ruhr area and directed at the major exits of the Ruhr, rather than, within the Ruhr area itself . . . would place the Ruhr in a position of economic isolation and begin the disintegration of the basic German economy"[24] and "that a small tonnage on a few carefully selected targets [the Survey describes them as four, which were never attacked] would stop all important North German canal traffic and through traffic upon the Rhine river for an indefinite period and that this could have been accomplished early in the war, thus diverting a tonnage which the railroads were not prepared to handle in full."[25]

Difficult To Reconcile

These statements are difficult to reconcile with the belief that the transportation system was too large and too complex for selection as a target. They are especially difficult to reconcile with the selection of targets which were scattered throughout Germany, heavily defended, and, in many cases until the advent of long-range fighter escort, were targets which could only be attacked while suffering unacceptable losses—targets which were of such a nature that their damage or destruction could only be added arithmetically to the gradually increasing damage to the enemy economy.

"The attack on transportation was the decisive blow and completely disorganized the German economy."

In contrast, damage to the transportation system was a shock that was felt in a geometrical ratio, both at once and in cumulation, throughout the war industries, as well as in the strategic, tactical, and logistical problems of the German Army and Air Force.

"Beyond Limited Capacities"

Further, it is difficult to reconcile the belief that the transportation system was beyond the "limited capacities of the air forces" with the statement of the Survey that "for the German system as a whole, 12,000 tons of bombs a month well-placed, or one-fifth the actual maximum monthly weight [on transportation] would have been sufficient . . . for the disruption of traffic."[26]

Whatever the limits, from May 1943 the bomb tonnage dropped on Germany alone by strategic air forces was never less than 14,000 tons a month and in general increased monthly to levels of more than 100,000 tons a month after September 1944—with sufficient added capability to blast France with 498,696 tons in 1944.

Contrast the total capability with the requirement of only 12,000 tons a month to secure the disruption of German transport and paralyze her war production and military movement. The Survey states that with the single exception of 7,823 tons in May 1944 there were never more than 4,003 tons aimed at German land transportation until September 1944,[27] and that such small tonnages as were dropped before September 1944 were when "transportation targets were attacked chiefly as alternates to other target systems or as targets of opportunity."[28]

There was a complete lack of realization that the transport system is the most vulnerable part of any economic or military organization, resulting in the relegation of the attack on transport to a mere "diversion" in tactical support of ground forces with an absence of strategic intent from the plans of attack, even tactical planning itself lacking "the systematic follow-up of an orderly plan."[29]

This inadequacy of planning for even the tactical support was such that of the operations preceding D-Day, the Survey says: "This phase of the action was laid

[20] Statistical Appendix to Over-all Report, pp. 13, 124, 136, 138, hereinafter cited as SAOR. ESBGWE, p. 142.
[21] ESBGWE, p. 5.
[22] "The Effects of Strategic Bombing on German Transportation," p. 2, hereinafter cited as ESBGT.
[23] Summary Report, p. 9.
[24] ESBGT, p. 5.
[25] *Id.*, p. 4
[26] *Ibid.*
[27] SAOR, pp. 13, 14, 20.
[28] ESBGT, p. 2.
[29] *Id.*, p. 4.

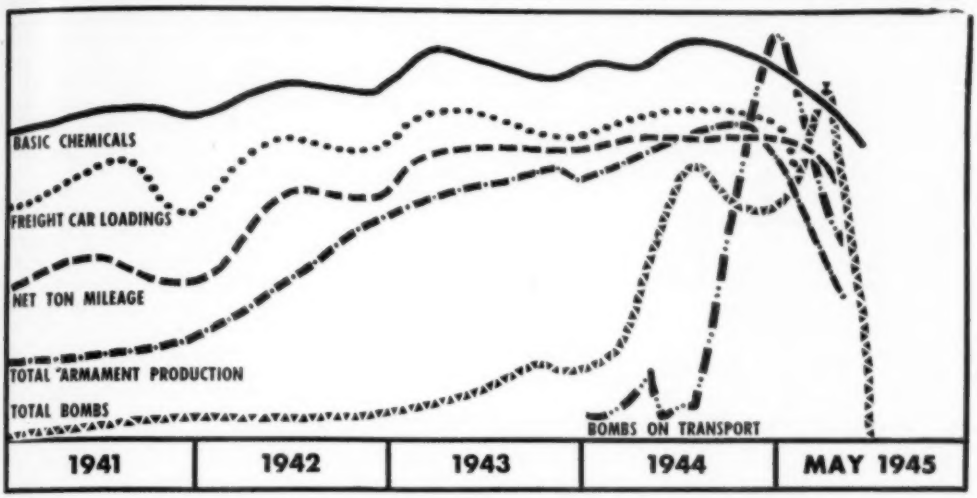

Fig. 1. Composite of U. S. Strategic Bombing Survey charts of German economic factors and tonnages dropped by strategic air forces on Germany. Separate curves are not to same vertical scale.

on hastily and with inadequate preparation. . . Earlier and more adequate planning could have insured its greater effectiveness."[30]

The course of actual events in the attack on transportation and what could have been done are best described in the words of the Survey:

Transportation Neglected

"During most of the air war against Germany the bombing of rail transportation was subordinate to other intentions of the strategic air forces. Although every major ground operation was preceded or accompanied by concentrated attacks on local rail facilities in or near the battle area, transportation was not singled out for priority attack as a strategic target system because of its size and complexity and the limited capabilities of the air forces. Therefore during the early phases of the war, until 1944, transportation targets were attacked chiefly as alternates to other target systems or as targets of opportunity.

"It was not until March 1945 that transportation as a target system received a definite plan of attack and then mainly for broad support of contemporaneous ground operations. In consequence the systems . . . were subjected only to sporadic attack until the middle of 1944, and it was not until September of that year that heavier attacks upon transportation facilities within the Reich began. No significant deterioration . . . can be traced to these attacks.

"The effects of the heavy air attacks beginning in September 1944 were felt at once . . . Under the impact of air attack concentrated primarily on the western part of the system, effects upon total carloadings of the Reischsbahn were immediately evident. . . . A sharp and uninterrupted decline set in. . . .

"Serious effects upon the nation's output developed at a fairly early date following the September and October 1944 attacks. . . . It became impossible for the railroad system to meet these transportation requirements, and the supply of critical components in the hands of most manufacturers was quickly exhausted with a resulting severe impact on virtually all munitions and other finished production. . . .

Consequences Great

"The consequences of the breakdown in the transportation system were probably greater than any other single factor in the final collapse of the German economy. . . . The lateness of the effective attack upon transport in relation to the completion of military operations prevented the full cycle of its effects upon production of military items from becoming apparent in the supply available to the armed forces."[31]

As to what could have been done, the Survey says: "Recognition of transport as a high-priority target system for strategic purposes would have permitted planning an attack best suited to reducing Germany's basic economic traffic and hence its basic industrial economy."

Additional Advantage

As quoted elsewhere, the Survey reports that an attack on the western periphery of the transport system by the strategic air forces was all that was needed. They find an additional advantage in a priority attack on German transportation:

"The use of the heavies against German rail targets would have preserved the French . . . facilities . . . for our own use and that of the French civil population during the severe winter of 1944-1945 . . . facilitated our own supply . . . permitted the fullest exploitation of the enemy disorganization and poor supply positions."[32]

It is pertinent to point out that much of the success achieved by the strategic bombing activity was wholly accidental, being a result of inaccuracy of attacks against other objectives in which single bombs wide of the target hit vital points in the transportation structure.

For instance, on October 14, 1944, a single stray bomb caused the collapse

[30] *Id.*, p. 5.

[31] *Id.*, pp. 2-3.

[32] *Id.*, p. 5.

of the Cologne-Mulheim Bridge, "completely blocking the channel of the Rhine. . . All water movement of coal to south Germany ceased." The importance of this event came from the fact that rivers and canals were the chief means of moving coal and "the German economy was powered by coal." Despite a high priority to the channel clearance work it was still blocked in March 1945.[33]

Another accidental hit of strategic importance resulted when "stray bombs" from a raid on a coal mine and benzine plant at Datteln "drained the most important 9-mile stretch in the whole canal system"[34] of Germany. When stray bombs scattered over the landscape could cause such damage it is easy to understand why the Survey states:

"Had a strategic pattern of attack been developed and applied—immediately it was decided to devote a significant bomb tonnage to transportation targets—more rapid economic results would undoubtedly have been secured."[35]

Principle of Objective

From the above it is easy to see the violation of that principle of war called the objective. This principle requires the selection of a decisive objective and, having selected it, the determination to stick to it. One authority has described it as to "select for destruction those elements which are most vital to the enemy's war potential." This is precisely what we failed to do.

The attack on oil plants is the one point where some claim of success might be made since it is indisputable that Germany ran out of oil. However, since the functioning of the plants and the distribution of their products depended upon the transportation system which could have been at any time, and finally was, disrupted by attack at points nearer to our bases, it can easily be seen that German oil production would have been most easily eliminated by stopping its transportation.

It is even probable that the long-delayed transportation attack was the vital factor in the final success of the year-long attack on oil since, as the Survey points out, "the German system of fuel supply . . . was particularly vulnerable to disruption due to transportation difficulties because of (1) the system of shipping components from producer to blending plants and (2) the large proportion of the total stock which was necessary to keep the pipeline filled."[36]

Since the synthetic-oil plants depended upon the transportation of coal for both raw material and power, for transportation of components to complete the production process, with final transportation to consumers, it is obvious that any transportation tie-up damaged the whole system. If a strategic transportation plan of attack had been followed from the earliest moment possible, or not later than May 1943, not only would the German troops opposing the Normandy landing have been deprived of fuel stocks described as "at their highest level" but the gasoline starvation of the German Air Force would have commenced far earlier.

"The consequences of the breakdown in the transportation system were probably greater than any other single factor in the final collapse of the German economy."

It is also true that even the oscillation between the various priority targets had some contributory effectiveness as it did cause some actual destruction of production means and end products. It caused the Germans to employ large numbers of people and considerable equipment in anti-air-raid organizations, and it caused effort to be expanded in dispersing and expanding plants. However the effect was, at best, only contributory in any positive sense and certainly was far from decisive.

As the Survey points out, the major effect was negative, causing the Germans to overhaul their production organization and construct additional facilities so that German production increased steadily until the beginning of the "diversions" against transportation.

Principle of Mass

The Survey's description of the course of the air war makes the conclusion inescapable that we violated the principle of mass, sometimes known as concentration. This principle requires the concentration of superior forces at the decisive point. A well-known authority has described it as to bring everything "to focus on a single target." As the Survey shows, we did not do this, either strategically or tactically. Strategically we never selected transportation as a decisive target. Tactically we used against it only bombers which the air commanders would "divert" from targets which were, in fact, nondecisive.

It is also clear that there was a violation of the principle of economy of force. This principle requires the distribution of our own forces to the best advantage. It has been described for the aërial weapon as follows: "To concentrate on a limited number of vital target systems instead of being compelled to disperse its force on numerous objectives of secondary importance."

We were not compelled to do so, but we did disperse our force "on numerous objectives of secondary importance." Our reversal of the principle is most aptly shown in the Survey's Summary Report where, under the heading "Secondary Campaigns," we find the following paragraph: "The attack on transportation was the decisive blow that completely disorganized the German economy. It reduced war production in all categories and made it difficult to move what was produced to the front. The attack also limited the tactical mobility of the German Army."[37]

Economy of Force

Our disregard of the principle of economy of force permitted the enemy to use it against us. The transportation system was so big, complex, and so intertwined that it was impossible to protect all the vital links, and those most susceptible of defense were those we could have most easily attacked with a continuous concentration of overwhelming strength.

Instead, by dispersing our efforts against widely scattered targets, many of them deep within the hostile defense system, we permitted the enemy to concentrate antiaircraft defenses around the relatively small number of our habitual targets (as the eighteen synthetic-oil plants) and to dispose his fighter defense for any desired amount of interception along our prolonged flight paths.

The violation of the principle of mobility is not as obvious as those described above, but it existed nevertheless. Mo-

[33] *Id.*, p. 18, Summary Report, pp. 13-14.
[34] ESBGT, pp. 21, 29.
[35] *Id.*, p. 4.
[36] IAAEGL, p. 8.
[37] Summary Report, p. 12.

bility is more nearly a quality which is a measure of the relative ease and flexibility of movement of the opposing forces. Its use requires that we either make ourselves more mobile than the enemy or render the enemy less mobile than ourselves.

No Strategic Plan

We never had a strategic plan or intent to reduce the hostile mobility, and such tactical plans as finally evolved were "laid on hastily and with inadequate preparation." The neglect of the ability to immobilize the enemy is most apparent from the description of Operation Clarion in the third War Report of the Chief of the U.S.A.F.

This operation, on February 22, 1945, was the solitary effort to employ all the strategic air forces against the German transportation system. This report states that "more than ten thousand Allied planes" (the Survey reduces this figure to between eight and nine thousand) were employed. As a result, says the third War Report, "Operation Clarion marked the end of large-scale mobility for the German armies."[38] The significant point of this statement, as applied to the use of air, is that up until this late date we had allowed them to retain that large-scale mobility.

The violation of the principle of coördination is clearly shown throughout the Survey. Though it is true that the directives to the strategic air forces were framed in language indicating "the desire to concentrate on targets which would affect front-line strength fairly quickly and thus render maximum assistance for the invasion of Western Europe,"[39] it is quite evident that such targets were not chosen. The strategic targets that were selected were those by whose destruction, it was felt "the use of air power could by itself bring about the collapse in Germany."

Landings Failed

That this failure of coördination was implicit throughout the strategic air concept is strikingly illustrated by the failure of the airborne landings at Arnhem. The Survey says that no transportation targets "were included in the over-all plan for that operation. . . The railroad net to the north . . . was not attacked at all . . . in spite of the fact that these were the very lines which carried the German supplies, troops, and material in the action against the airborne landings."[40]

During the same month over 195,000 tons of bombs were dropped on Germany, over 48,000 tons being merely aimed at "industrial areas." It cannot be said that strategic air was adequately coordinated in support of this major strategic move by airborne ground forces.

"Had a strategic pattern of attack been developed and applied —immediately it was decided to devote a significant bomb tonnage to transportation targets— more rapid economic results would undoubtedly have been secured."

The Allied violation of the principles of war in the use of strategic air forces was not the sole instance in which the principles were violated, as has been pointed out by Maj. Gen. J. F. C. Fuller in an analysis of the Battle of the Bulge. However, in the battle and in the war we were finally successful in spite of the wastage and the time lost as a result of violating the principles, because we were able to throw such overwhelming strength at the enemy.

The words of the Survey, in describing the lack of planning for a strategic air attack on transportation, apply equally as well when applied to the total effort to collapse Germany: "Toward the end of the effort the weight of the attack became so overwhelming that this effect was nevertheless secured."[41]

A-Bomb Equivalents

As an indication of the extent of the misuse it may be of value to translate the strategic bombing effort against Germany into terms of atomic bombs. The Survey has estimated that the Hiroshima atomic bomb caused actual destruction in the city equivalent to 2,100 tons of ordinary bombs, although theoretically the A-bomb is much more powerful.[42] By simple arithmetic then, the 1,419,604 tons of ordinary bombs dropped on Germany alone by the Allied strategic air forces was the equivalent of 676 atomic bombs.

Further, the figures show that for the 11-month period October 1943 through August 1944 the equivalent of 14 atom bombs a month were dropped on Germany. For the last seven months of the war the average atomic equivalent of 52.6 bombs per month were loosed on Germany. Even discounting the ordinary bombs by 50 per cent, this still leaves Germany suffering the equivalent of an attack of nearly 350 atom bombs.[43]

It is worth remembering that while all these equivalents of atomic bombs were being dropped on Germany, she was increasing her industrial war production. In addition she was at the same time conducting a fierce ground war on the fronts—and part of the time on three fronts. Even under this heavy attack, and while suffering severe reverses in the field, the morale of her people did not crack.

Even more—she was conducting a spirited air defense, a sea campaign of dangerous intensity, and was successfully developing new weapons such as the V-1 and V-2, the snorkel submarine, new war gases, jet fighter aircraft, and was well along on antiaircraft guided missiles.

Russian Experience

That this strength of a modern nation is not an isolated example can be seen from the experience of Soviet Russia. The Soviets lost an average of sixty per cent of their coal, steel, and aluminum production, and millions of lives without dimunition of fighting spirit and ability.

The figures and facts shown above indicate that the Allied air effort against Germany was tremendous even when translated into the terms of the atomic bomb. They serve to indicate the enormous power of the air weapon.

However, in securing the final victory, our misuse of the tremendous power of the air weapon is now causing us severe difficulties in securing a solid and lasting peace. Following the desire of the air enthusiasts to attempt destruction of the enemy's war potential as embodied in his industrial plants and his cities, while not fatal to his war effort, wrought such widespread damage to Germany that she is a weak and sick nation.

Her weakness is such that we must restore the strength that we unneces-

[38] "The War Reports," pp. 429, 430.
[39] ESBGWE, p. 3.
[40] IAAEGL, p. 48.
[41] ESBGT, p. 4.
[42] Summary Report (Pacific War), p. 24.
[43] SAOR, p. 13.

sarily destroyed in order to achieve a stable world economy. We must now restore her health in order that she may not fall a victim to the pestilence endemic to the Eastward and thereby become a reënforcement to the source of the disease.

Two Classes

The air enthusiasts may be divided into two classes in accordance with the rationalization of their intention to use the air weapon to destroy the enemy war potential.

One class advocates "the method of extermination . . . the elimination of the enemy as a world factor."[44] This can be disregarded as the vaporings of ill-advised extremists. It is obvious that the United States did not have a policy of extermination toward either Germany or Japan. It is equally obvious that in order to eliminate an enemy as a world factor one would have to exterminate the enemy nation completely. Apart from the inhumanity of the proposal, it disregards the fact that the result of such action is the creation of a political and economic vacuum, which in turn would be a new and unbalancing world factor.

The other class advocates the destruction of industries as the heart of the enemy war potential—this being the quickest means of winning the war, at the conclusion of which we would resume our peacetime policy courses.

Disregarding the fact that bombing of industries in World War II did not speed up the war and, in the cases of both Germany and Japan, had little if any direct bearing on their defeat, the idea that the quickest method of ending the war is the sole consideration in selecting the means and methods of warfare is in itself erroneous. For if the means of quickly ending a war will destroy the means of attaining a lasting peace it follows that policy would require a change in the means or method.

Purpose of War

Wars are not fought merely to be won, they are fought in order that the victor may continue to follow the policy which led to the use of the final argument of force. War and peace are merely two sides of the coin of national policy.

In the same manner, war potential and peace potential are the two sides of the coin of national potential. A wise policy cannot consent to the destruction of any part of the enemy's national potential which will impose a burden upon the victor in following his policy concerning the use of the foe's potential.

This is well-proved by the increasing burdens upon the American taxpayer as a price for our misuse of strategic air forces. As a result of the havoc wrought upon the enemy peace potential, when we considered it as war potential, the United States is now faced with the necessity of rebuilding the national potential to a level where we can hope to effect our policies for a lasting peace.

"Using the available guided bombs, a monthly tonnage of only 1,300 tons would have maintained a complete interdiction of Japan's railroads."

Our damage to the enemy potential in the form of industries had, at best, only an incidental value in shortening the war, which makes it obvious that our use of the means was misdirected both as to the course of the war and as to our national policy.

War Against Japan

The course of the war against Japan has led to some unfounded claims that strategic air forces, by attacking the enemy's industries, defeated her and led her to surrender. These claims are not based on the reports of the Survey. The pattern established by the Survey for the Pacific is essentially the same as for Europe. The widespread aërial destruction of industrial and urban areas was hardly even contributory to the victory.

The Summary Report says that the loss of sea-borne communications was strangling Japan, and that "Japan's economy was in large measure being destroyed twice over, once by cutting off of imports and secondly by air attack."

The railroads were hardly attacked at all. Using the available guided bombs, a monthly bomb tonnage of only 1,300 tons would have maintained a complete interdiction of Japan's railroads. The Survey says that this "would have more effectively and efficiently destroyed the economic structure of the country than individually destroying Japan's cities and factories." Japan would have been "incapable of any sustained industrial production," of feeding her cities, or "of rapid large-scale-movements of troops and munitions."[45]

So far as strategic air was concerned its most effective use against the Japanese war economy was in the aërial mining campaign "which sealed off the vital Inland Sea" as its part in the blockade of Japan and where "strategic bombing assumed the rôle of an accelerator to assist and expedite forces already in motion" toward surrender.

Marianas Campaigns

These forces were set in motion by our mid-1944 naval and amphibious victories in the Marianas campaigns. These caused the accession of a new Japanese Government which then commensed its long internal struggle to surrender.[46]

It is clear that the collapse of Japan stemmed from a national paralysis resulting from the disruption of her transportation lines, which happened to be vulnerable to the forceful use of sea power. When thoroughly blockaded, Japan was incapable of waging war.

The lessons of World War II as to the use of strategic air power are clear. With or without atomic bombs, strategic air force wields tremendous power, and, as with all powerful machines, its incorrect use causes waste or harmful results in the same measure as its power.

National policy cannot allow it to be used in such a manner that it will impede the continuous course of that policy. It cannot be allowed to attempt a campaign independent of the other forces of the Nation. It achieves its greatest success when it is coördinated directly with the action of other forces, not for the destruction of enemy war potential but rather for the defeat of the enemy armed forces.

Lessons Confirmed

World War II but confirms the lessons of the past: when the enemy's armed forces are defeated in the field his war potential lies undefended in our grasp; then national policy can direct that potential to its uses in constructing a lasting peace.

(The views herein expressed are those of the author and not necessarily those of the Navy Department.)

[44] "Victory through Air Power," A. de Seversky, p. 101.

[45] Summary Report (Pacific War), p. 19.

[46] "Japanese Struggle to End the War."

Derusting Equipment in the Field

The Use of Iodine as a Pickling Acid Inhibitor

Dr. Karl F. Hager and Morris Rosenthal

Experiments show that small ordnance items may be derusted quickly and easily even under field combat conditions

IN times of international crisis one of the enemies of the Nation's defense is corrosion. It not only imposes a several billion dollar annual tax on our ecenomy, but, more deadly, it eats into our vital metals and equipment so as to deplete our Nation's metal reserves permanently.

Ordnance has, among many problems, two of outstanding significance: (1) to keep materials from corroding and (2) to rehabilitate rusted ordnance equipment. Much has been written and great progress has been made concerning the first problem although it is still only partially solved. But the second problem—the recovery of rusted ordnance materials—can be totally solved.

Science and the laboratory have combined to make it possible to remove the rusted areas from iron and steel without noticeably injuring the unrusted portions.

Physical methods of rust removal, such as sandblasting, are very well known and are employed on the outside of simple geometric surfaces where losing a percentage of the unrusted metal can be tolerated.

Acid Pickling

The commonest method of rust removal, where geometric shape is of no consideration and where the hollow interiors of rusted equipment must be reached, is by acid pickling.

It is well known that the oxides of iron are readily dissolved by acids, but iron and steel also fall prey to this rust remover. In recent years chemical compounds known as rust inhibitors have been added to the acids in order to decrease their attack on the unrusted metal without appreciably altering the rate of scale removal by the acid.

These inhibitors are classified into organic and inorganic compounds. The latter are usually salts of metals like arsenic and antimony which are nobler than iron and which, therefore, are plated on the iron forming a negatively charged, fairly continuous film over the metal surface. In the electrolytic cell formed by this iron-to-nobler-metal couple, the high hydrogen overvoltage of the plated metal prevents the discharge of the hydrogen, thus preventing the generation of hydrogen and attack on the pure iron.

Organic compounds are extremely numerous and generally contain nitrogen, oxygen, sulfur, and other elements such as phosphorus, chromium, bismuth, etc., belonging to the fifth and sixth periodic groups as vital constituents. These organic compounds generally form a film over the cathodic regions of the pickled steel surface and thus prevent the attack of the hydrogen ions of the acid against the unrusted base metal. Many chemical manufacturers produce these inhibitors commercially, and a list of 112 of these substances may be found in the Corrosion Handbook, edited by H. H. Uhlig, and published by John Wiley & Sons, Inc.

In time of war, however, certain conditions arise to cause field equipment and small arms to become rusted and eventually unserviceable. It might be possible to obtain greater use of this equipment if the rust were removed, but commercial pickling is not available. Field conditions are seldom such that the normal chemicals for rust removal are obtainable, especially the acid pickling inhibitors.

The logistics problem makes procurement and delivery of the heretofore necessary chemicals a hardship and an impossibility in many instances. Simplicity of procurement of the chemicals coupled with no additional burden on heavily laden supply lines is the desired goal.

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Iodine an Inhibitor

Research at the Fort Bliss Ordnance Laboratory has produced an acid pickling inhibitor obtainable at almost every field position. Tincture of iodine, long thought by scientists to be an accelerator of acid attack on metals, has been proved to be an excellent inhibitor. Addition of one per cent of a two per cent tincture of iodine solution by volume to a five per cent sulfuric acid pickling bath would result in a ninety-five per cent retardation of the acid attack on the pure metal, without decreasing the rate of dissolution of the rust.

Tincture of iodine as such is not generally shipped to forward areas, but is usually shipped with the iodine crystals separate from the alcohol contained in drums. The tincture is prepared for medical use by dissolving the iodine in the alcohol. It has been found by the Ordnance Laboratory that the addition of 0.05-0.1 per cent of the iodine crystals alone to the acid produces excellent inhibition. In this manner—using the iodine crystals without the addition of the alcohol—the alcohol may be conserved and transportation and storage of an inflammable material eliminated.

With the use of the iodine crystals it is necessary to wait about five minutes for the iodine to dissolve and disperse throughout the acid. However, by dissolving the needed iodine in a small volume of alcohol, dispersion is almost immediate.

Sometimes the tinctures of iodine obtainable are made by dissolving the iodine crystals in an aqueous potassium-iodide solution so as to obtain almost instantaneous dissolution. If such tinctures are available, they can be used with results as good, if not better, than the other methods mentioned.

Any Acid Usable

Any usually obtainable acid, ranging from hydrochloric through acetic acid, may be successfully inhibited by either the pure iodine or its tinctures. At advanced and isolated positions, however, even the acids may be difficult to obtain. In such cases, the pure or impure sulfuric acid from the storage batteries of vehicles may be used for the purpose of derusting.

Battery acid ranges from about a thirty-two per cent concentration in charged batteries to about a twenty per cent concentration in run-down batteries. This battery acid can be used undiluted for rapid rust removal, and the iodine is extremely effective in preventing the base metal from being attacked by the acid. In the event that there is not enough concentrated acid to cover the pieces of equipment to be pickled, the acid can be diluted to as low as five per cent by the addition of either distilled or impure water so that the acid volume would be sufficient to do its work. The time required to remove the rust is longer as the acid becomes more dilute. The equipment is removed from the pickling solution when the rust is no longer visible, but it may be left in the acid for a longer time without injury because of the presence of the inhibitor.

A 0.1 per cent iodine concentration in the acid provides sufficient protection, but the addition of an excess of iodine will not retard the rate of rust removal to any noticeable degree and will provide an even greater degree of protection to the base metal against acid attack.

The container used for the acid pickling bath may be of any readily available material that will hold water. Its size is governed only by the size of the equipment to be derusted. The iodine inhibitor will prevent the acid from eating into iron or steel containers, so even empty gasoline or oil drums may be used for the pickling of small arms and other small equipment.

Oiling Is Important

In this manner, even at advanced and isolated positions, personnel may remove rust from their equipment without removing an excessive amount of the base metal. Immediately after removal from the pickling bath the equipment should be rinsed briefly with water, dried, and covered with oil in order to give a temporary protection against the rerusting of the treated equipment. Any type of oil film ranging from crankcase oil to hair oil will suffice.

For operations based further back where larger volumes of material can be handled and suitable facilities exist for constructing large pickling baths, the missing item is usually the acid pickling inhibitor. Here, too, iodine may be used, but it does not give any rust-resisting protection to the highly active, freshly pickled metal surfaces unless the residual acid is rinsed off and the equipment is rapidly dried and immediately oiled. Otherwise rust immediately begins reforming on the metal.

Water-soluble cutting oils, usually found in machine shops, are 80 per cent effective acid pickling inhibitors when used in 0.2 per cent volume concentrations with sulfuric acid. Furthermore, they have been found to provide a rust-resisting protective film over the freshly pickled surface.

Dangers Lessened

It now seems obvious that military equipment and arms may be safely and conveniently derusted in the field without fear of gaseous hydrogen, generated from unhibited acid attack on steel, causing an acid spray injurious to personnel and equipment in the vicinity. Tests show that field pickling can be done with less danger of hydrogen gas embrittling the steel. They also show that inhibitors readily available in the field can be utilized to advantage without depending on special rust-eliminating and preventing agents being brought forward via heavily burdened supply lines. The net gain would be a great reduction in equipment losses, better maintenance of weapon serviceability, and the alleviation, in time, of the supply burden all the way from the zone of the interior; and the manufacturing load would eventually be reduced.

Rust inhibitors are especially important in packaging ordnance equipment for storage or shipment. Writing in the September-October 1950 issue of ORDNANCE, Maj. Gilbert Foster, U.S.A.F., told of the use of volatile corrosion inhibitors for which the following advantages were claimed:

1. Excellent long-term storage protection when properly applied. The length of time that the inhibitor will remain effective is largely dependent upon the ability of the barrier materials to maintain the inhibitor vapor level in the package.

2. Prevent corrosion even if the package becomes punctured or damaged to the extent that moisture vapor is able to enter. The vapors of the volatile corrosion inhibitor act to neutralize any moisture entering. Properly applied, it will protect ferrous metals against corrosion in the presence of one hundred per cent humidity but for a shorter period of time than when completely sealed.

3. Vapors will protect surfaces of assemblies that cannot be protected by other means because of the difficulty of applying rust preventives to some surfaces with the usual procedures.

4. Highly adaptable to various packaging methods. Available in crystal form or more commonly as a coating on many types of paper and materials.

5. Cleanliness in application.

6. Eliminates degreasing operations and the various hazards resulting from them.

7. Protection under arctic, temperate, or tropic storage conditions.

Ammunition Storage Overseas

Organization and Operation of Communications-Zone Depots

by

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Much of the success of our forces in combat depends upon the proper care and issuance of ammunition of all types

ANY appreciable shortage of ammunition in combat will result in increased loss of life and may result in tactical defeat. The proper location, organization, and operation of the ammunition depots in an overseas theater of operation is one of the key factors in assuring a continuous and adequate supply of ammunition to the combat forces.

In addition to the normal problems which are existent in any depot operation, the ammunition depot has two factors which make the job particularly arduous. The first of these is the large tonnage involved in each shipment and in the total amount stored. The second is the fact that because of the nature of the commodity being stored it must be dispersed over a large area in order to insure safety.

Depot Defined

For purposes of general discussion, the term ammunition depot may be considered to include all storage facilities for ammunition from the ammunition supply points supporting the front-line troops to the base ammunition depots in the communications zone. Between these extremes are the intermediate and forward communications-zone ammunition depots and the army ammunition depots.

While it is natural to expect considerable difference between the depots in the rear areas and the ammunition supply points in the forward areas, it should be realized that the principal difference is one of size and degree of permanence rather than of method of organization and operation. As the fighting progresses, new ammunition supply points will be established as necessary to furnish ammunition to the combat troops. When a new ammunition supply point is established the older one will either be closed out or become the nucleus of an army ammunition depot.

In turn, as the army moves forward, its ammunition depots may either be closed out or become the nucleus of the communications-zone depots. Depots will be established progressively forward along the main lines of communications as required.

Communications-Zone Depot

This discussion will consider primarily a communications-zone depot operated by one ammunition battalion headquarters with the necessary supporting troops. The operation of such a depot is typical of most ammunition-depot operations in an oversea theater.

The size of the area required will be determined by the stock level authorized and the size of the force supported. In the case of an ammunition supply point the volume of ammunition will not exceed a few thousand tons, but the turnover will be rapid; whereas the communications zone depot may contain appreciably more. In selecting a site for an ammunition depot, consideration should be given not only to the immediate requirements for storage space but also to possible expansion requirements.

While approximately five thousand tons of ammunition can be stored per square mile, it is advisable to provide for expansion by determining area requirements based upon a lower figure. It must also be remembered that within any area there may be unusable portions which would be excluded from the computation of available area unless they can be utilized to furnish required safety distances without it being necessary to store ammunition in them.

If the storage of ammunition must be limited to roadside storage along the existing roads, only one thousand tons can be accommodated per mile of road. The total road requirements may vary from twenty-five to one hundred miles.

In selecting the site for an ammunition depot, several factors should be given consideration in addition to the basic problem of having sufficient land. The site must be accessible from the main roads and should also be accessible by rail. The roads should be in such condition that they will stand up under heavily laden trucks in all weather conditions with a minimum of engineer maintenance effort.

It is also necessary to have a road net within the ammunition depot to provide for its internal operation. The internal roads should be of the best quality possible, but they do not have to be as wide or of as good construction as the main access roads, since the traffic will not be as heavy. One-way traffic may be utilized and turn-arounds provided at frequent intervals. The operation of a large ammunition depot will warrant considerable road improvement and construction.

All-Weather Site

The site selected must be such that it will be usable during all types of weather and that the ammunition will remain accessible and not be damaged by flood water. This was a major problem in many areas during World War II, especially in the tropics. The ideal area is one where there is little or no topsoil and a hard base of rock or gravel. Some of the coral islands in the Pacific proved ideal from this standpoint.

In selecting a site, consideration should be given to avoiding places

where the danger of fire would be particularly great due to the nature of vegetation, and if possible, places should be selected where the local water supply is adequate for fire fighting.

The site selected should also be such that it will give the greatest possible security from any probable enemy action, since the size of these depots makes it impracticable for them to be evacuated in a general withdrawal. Locations near airfields should be avoided in order that the ammunition depot will not be subject to hazards incident to the operation of aircraft and to reduce the probability of the depot being hit during an enemy attack on the airstrips.

Bombing Dangers

This point was well brought out by the experience in the Southwest Pacific area in which the only case of a communications-zone ammunition depot being hit by Japanese bombs was at Port Moresby where one of the depot areas was located in line with an airstrip. Occasionally the enemy would overshoot the target—dropping his bombs on the ammunition depot.

What has been said applies as far as practicable to the selection of ammunition supply point sites. In addition, these sites should be selected so that they are defiladed from enemy fire and are not under direct enemy observation. It is not possible to conceal completely the presence of an ammunition depot or supply point from observation. However every effort should be made to conceal the extent and capacity of the installation and particularly to conceal any increases or decreases in activity which might disclose operational plans.

This can be accomplished by conducting receiving and issuing operations at night as far as practicable, by using irregularly shaped stacks, and by utilizing natural cover wherever it exists. In addition, the cutting of new roads and trails should be kept to a minimum.

An ammunition depot is normally organized into areas corresponding to the functions to be performed. This is done to facilitate the work and to isolate the hazards involved. One of the operating areas established is the storage area. At least two storage areas are required to provide dispersion and facilitate operations.

It is generally desirable to have three such areas in order that receiving operations may be conducted in one while issuing operations are conducted in the second and inventory operations in the third. When this is done, the operations are rotated in the areas on such a schedule as to allow for the proper receipt, inventory, and issue of the ammunition.

In general, there are two principal systems which may be used in laying out ammunition storage areas. The first is area storage, and the second is roadside storage. Each of these methods has its advantages. Roadside storage results in the minimum of engineer effort required to maintain or construct the roads necessary for depot operation. It also has the advantage of giving a good degree of dispersion, and it facilitates concealment and camouflage.

However, when roadside storage is used, the area of the depot operation is generally so extended that it cannot be efficiently controlled from the main depot office, and it is necessary to set up subdepots. Roadside storage is only practicable if the depot is in a locality which has a well-developed road net.

On the other hand, field storage provides a compact depot area which is easy to supervise, but at the same time it requires a greater amount of engineer effort to construct and maintain roads and is more revealing to enemy observation. It will generally be found that a combination of the two methods will best serve the purpose of giving a satisfactory operating ammunition depot.

Segregation Area

A segregation area is necessary, since ammunition is frequently received in a mixed condition, and it is more satisfactory to segregate it in a separate area than to attempt to do so in a storage area. The same area may be used for the segregation and classification of ammunition returned from the using units, or this work may be accomplished in a salvage area set aside for this purpose. A renovation area is also necessary, particularly in communications-zone depots, since a considerable amount of renovation work must be performed.

An area must also be provided for the demolition of ammunition, including a power-burning ground and detonation pits, together with the necessary shelters for the protection of the personnel operating in the area.

"Proper storage of ammunition is the key to the success of the ammunition mission since no amount of ammunition furnished the troops will be sufficient if it is not in proper condition when received."

Vehicle Areas

In addition to these principal operating areas, it is necessary to provide areas for holding incoming vehicles until they can be served, for assembling vehicles after they have been loaded, for the storage of enemy ammunition, and for the bivouac of the units operating the depot. The bivouac area should be as near to the depot office as safety will permit in order to facilitate assignment of work.

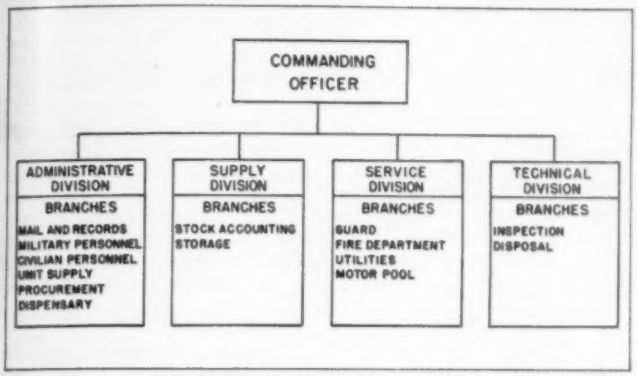
The storage areas may be further divided into subareas and each subarea made the operating responsibility of one ammunition company. This has the advantage of fixing the responsibility for the operation in any one section and also allows the ammunition company to operate as a unit. The sections may then be further subdivided into field storage units (F.S.U.).

A field storage unit is a group of stacks of ammunition located in such a way as to be isolated from adjacent field storage units by sufficient distance to prevent the spreading of fire or the detonation of adjacent ammunition. Each field storage unit will normally contain only one category of ammunition.

An ammunition depot will normally be operated by an Ordnance ammunition battalion headquarters but may be operated by a provisional headquarters composed of Ordnance ammunition personnel taken from the theater bulk authorization of personnel or assigned on detached duty from other Ordnance ammunition units.

The necessary ammunition companies and other service troops will be attached to this headquarters for the depot operation, and the additional personnel necessary to man the depot office must be drawn from the depot office sections of the Ordnance ammunition companies. There may also be combat units, such as antiaircraft, located in the depot area for its security.

These units are not under the operational control of the depot commander unless he is designated as the area de-



Typical ammunition depot office organization.

fense commander in an emergency, and he then exercises operational control over the tactical activities of all units attached to the depot for its defense.

The principal operating divisions of an ammunition depot office are: the administrative division, supply division, service division, and technical division (see organization chart above).

Administrative Functions

The functions of the administrative division are the normal ones of any such division; that is, the preparation of correspondence, requisitioning of clothing and other supplies for the unit, handling of paperwork in connection with personnel, and the local procurement of supplies.

The supply division is responsible for all functions related to the supply operation of the depot and includes the stock-accounting branch and the storage branch. The functions of the stock-accounting branch are stock-accounting, inventory control, and action in connection with the initiation of ammunition shipments. In carrying out these functions it determines the stock level for each ammunition item on the basis of the level of supply authorized for the depot and maintains records of credits allocated and records of ammunition on hand.

This branch also processes incoming ammunition shipping documents and prepares shipping documents on outgoing shipments, keeping the storage branch advised of anticipated receipts and shipments. Based upon the information furnished by the stock-accounting branch, the storage branch arranges for and supervises the receipt, storage, and issue of the ammunition sent to it.

The service division, as the name implies, provides the necessary guard, fire, utility, and transportation services within the depot. The technical division is headed by the surveillance officer and contains the necessary technically qualified personnel for supervision of the inspection and renovation of ammunition and the disposal of unexploded ammunition or components. It is in this division that the most technical ammunition knowledge is required and the responsibility for the most hazardous work rests. The functions of the technical division include the inspection of all technical operations in the depot to prevent conditions which might result in a fire or explosion.

The major movement of ammunition to and from a depot involves the receipt of the ammunition, its shipment to another depot, or its issue to a using unit. An ammunition depot will ordinarily receive advance information of incoming shipments. When such information is received, the storage location for each item of ammunition will be selected by the depot office and the operating unit of the area advised.

Incoming Shipments

Incoming shipments may be by truck or other type of transportation. If they arrive by other than truck, it will be necessary to transfer the ammunition to the storage area by truck. In this case a copy of the general storage plan for the ammunition being received should be available at the transfer point in order that trucks may be properly loaded.

An individual storage slip is prepared for each vehicle indicating the destination of the ammunition it is hauling. The exact storage data will be indicated on the slip by the receiving checker at the time it is off-loaded in the storage area. When shipments arrive by truck from another supply installation they will first report to the depot office where the shipment is verified and individual inspection made of the vehicles and the ammunition they contain.

The storage location is noted on the stores slip which accompanies the vehicle, and a checker will also be sent with the truck to guide the vehicle to the storage location and to supervise the off-loading of the ammunition. He will verify the lot number, condition, and quantity of ammunition received and make the necessary entries on the magazine data card and stores slip.

The information on the stores slip will then be posted to the records in the depot office. When mixed items are received, care must be taken to assure that each type is delivered to the proper storage location and that the proper entries are made on the locator record.

Ammo from Using Units

It will frequently be necessary for an ammunition depot to receive ammunition from using units. When such ammunition is received, it should be picked up as unserviceable stock until properly identified and inspected.

The bulk of the ammunition leaving an ammunition depot will be by shipments to other ammunition installations. The frequency and size of these shipments will depend upon the location and mission of the depot. Those in the combat zone will normally be smaller and more frequent than in the communications zone.

Upon receipt of instructions to ship ammunition, the depot office will verify the availability of the ammunition and determine the storage areas from which the shipments will be made. Based upon this determination the shipping documents will be prepared and arrangements made for the necessary transportation. Most ammunition shipments will be by means of Transportation Corps facilities since the ammunition depot has only a minimum of motor-vehicle equipment.

The receiving depot should be advised of the time of departure, the

method of transportation involved, and any other pertinent information which may assist in planning for the receipt of the ammunition. If available, electrical means should be used for transmitting this information. The shipments may be made by truck convoys loaded directly at the ammunition depot or by rail, water, or air—in which case it is necessary to load the ammunition on trucks at the depots and transfer the load to other means of transportation at some transfer point.

Direct Issue

Most of the issue of ammunition to using units will take place at ammunition supply points in the combat zone. However any ammunition depot is likely to have a small amount of direct issue to units training or operating in the general vicinity. Such issues are based upon transportation orders brought to the depot office by the commander of the ammunition train of the unit receiving the ammunition.

Upon receipt of the approved transportation orders the depot office will verify the availability of the items requested and indicate their source within the depot. Stores-issue slips will be prepared for each vehicle showing the location and quantity of ammunition to be loaded on that vehicle. A checker will accompany each vehicle to the point at which the ammunition is to be loaded, supervise the loading, and sign the stores slip to indicate the actual amount placed aboard the truck.

Duplicates of the stores-issue slip will be given to the driver for use by the receiving unit. The original will be used to post the records of the depot. The train commander will acknowledge receipt of the ammunition by signing the transportation order which has been certified correct by the depot office. One copy of the transportation order is then used as a credit voucher for the stock-record accounts and the other copy is retained by the train commander as a record of the total quantities received. In general, all shipments and issues should be by complete rounds and should consist of a minimum number of lot numbers.

Proper storage of ammunition is the key to the success of the ammunition mission since no amount of ammunition furnished the troops will be sufficient if it is not in proper condition when received. Basically, good storage involves compliance with safety procedures and the protection of the ammunition from the elements. It is essential that safety procedures be followed in order to minimize the loss of ammunition and life.

The safety regulations contained in technical manuals, the Ordnance Safety Manual, and Ordnance Corps safety bulletins should be followed as far as the conditions in the field will allow. These safety regulations should be modified only to the extent necessary, due to shortage of facilities and urgency of operations.

For purposes of ammunition storage in an oversea depot, all ammunition has been divided into seven categories, based upon comparable storage risks. These categories are shown in appropriate field manuals together with quantity-distance tables setting forth the proper quantities and dispersion for such ammunition. These quantity distances should be adhered to as rigidly as possible.

With the great increase in the use of rocket ammunition there has been added an additional hazard in ammunition storage. The flight of the rocket when ignited adds greatly to the range over which a hazard exists in case of a fire involving rocket ammunition. Because of this fact it is necessary that rocket ammunition be stored in such a way that a barricade is in front of the rockets to stop their flight in case the rocket motors are ignited. Rockets should also be arranged so that they do not point in the direction of any other ammunition, and rocket storage should be on the outer edge of the storage area rather than in the center.

Dunnage Necessary

Protection from the elements requires adequate dunnage, shelter, and ventilation. Dunnage is necessary to keep the bottom tier of ammunition off the ground and to prevent its sinking into the earth in case of muddy conditions. It is also necessary to put dunnage between the various tiers in a stack to assist in furnishing adequate ventilation. Often local timber or other material will provide the necessary dunnage.

However it is sometimes necessary to store ammunition where there are no local sources of dunnage, and in this case it is necessary to provide for shipment of dunnage to the area. This was found to be particularly true in the Southwest Pacific during World War II, and it became necessary to establish as a standard procedure the shipment of dunnage with each shipment of ammunition to a new area. The shelter provided for ammunition need not be elaborate and may range from a small corrugated-iron shelter or a tarpaulin supported on a framework to a rather elaborate warehouse.

Ventilation Important

In any case, adequate ventilation must be provided for the ammunition. This is particularly important in tropical climates. If proper ventilation is not provided the high humidity and temperature will greatly increase the rate of deterioration of the ammunition. Tests conducted in New Guinea during the last war indicated that a temperature difference of twenty degress was not unusual between storage under a tarpaulin which was laid closely on an ammunition stack and one properly ventilated.

The storage areas must be kept clean and free from any extraneous material which would add to the fire hazard. The area around each field storage unit should be cleaned, and necessary firebreaks should be provided within the area.

Closely allied to the storage operations of the depot are the surveillance and renovation of the ammunition. Surveillance consists of the inspection of the ammunition to determine its condition, correction of minor deficiencies, and recording and reporting the results of the inspection. Such inspection should be frequent in order to determine signs of deterioration before such deterioration has progressed very far.

An Ordnance ammunition renovation unit will normally operate renovation facilities in the communications-zone ammunition depot, and personnel from these units will be dispatched to other installations when required.

Only the high lights of the organization and operation of an ammunition depot in an oversea theater have been covered, but from these it can be seen that the operation is complex and requires a considerable amount of planning and control by the officers in charge of the depot.

Streamlining Acceptance Inspection

New Military Sampling Tables Standardize Evaluation Procedure

Dr. William R. Pabst, Jr.

NEW sampling tables for inspection by attributes have just been published and released. MIL STD 105A entitled "Sampling Procedures and Tables for Inspection by Attributes" contains the sampling plans developed for use in the acceptance inspection of all military purchases where applicable. The tables were prepared concurrently by all the armed services —Army, Navy, Air Force, and various branches and subdivisions. The new standard is a direct development of the previous national military establishment engineering standard JAN STD 105, the former Appendix X of the Navy General Specifications.

Not a Cure-All

The tables and the system of evaluation inspection that they imply are not, of course, a cure-all for inspection ills.

The system is designed to eliminate the obvious troubles: the serious differences between inspectors because of varied and specialized backgrounds, the rejection of good material because of an occasional "crack-down" by the inspector, the acceptance of bad material through pressure or moral suasion on the part of the contractor, the absence of a clear channel of authority through the inspector, and the clogging red tape of treating each item of inspection as of equal importance.

The system eliminates these and similar inspector troubles by establishing clarifying standards, by assigning relative importance to different items and to the different requirements of each item, by establishing uniformity in lot-evaluation procedures, by clarifying channels of information, and by securing minimum-data requirements for adequate control based on statistical quality control methods.

The striking feature of the new standard is its coverage. It contains approximately 225 single sampling plans, nearly 3 times as many as in the previous standard. The extension of tables makes it applicable not only to the more common type of military acceptance inspection of a per-cent-defective basis but also to inspection by defects per hundred units, appropriate to jeeps, wire, and other products.

The new standard contains sampling tables for lots from 2 or more units up to lots containing 550,000 and over. It includes a range of acceptable quality levels (AQL) from 0.015 up to 1000.0. AQL values of 10.0 or less can be expressed in per cent defective or defects per 100 units; over 10.0 they are expressed as defects per 100 units.

The basic principles of the new standard follow closely those of JAN STD 105 and can be described as follows:

Sampling inspection is the inspection of the units of a random sample from which lot quality is evaluated for purposes of lot acceptance or rejection. Inspection of a sample is not new, but as used in the past, with the sample drawn as a percentage of the lot size, it usually resulted in unknown and variable risks of accepting undesirable material.

Known Risks Established

The sampling tables used now with properly determined sample sizes and acceptance numbers establish uniform lot quality requirements and known risks. These risks are given in the operating-characteristic curves which are furnished with each sampling plan.

Acceptance inspection deals with entire lots of material as presented by the contractor and not with individual items or units within the lots. The entire lot is either accepted or rejected.

Acceptance inspection or "evaluation inspection" is designed to measure the quality of lots offered by the contractor so that lots equal to or better than the acceptable quality level can be accepted and the substandard lots rejected. Acceptance inspection by the Government inspector under standard inspection is never for the purpose of directly improving the quality of the lot by screening out its defective items.

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Responsibility

It is the responsibility of the contractor to insure that the material is made properly or quality improved to the necessary extent before it is submitted to the Government for evaluation. Screening inspection, where necessary to improve quality, is a contractor responsibility. Acceptance inspection evaluates the lot quality after the contractor is satisfied that the lot meets the acceptable quality level.

Lot quality standards as well as individual unit standards are established for material so that each Government inspector at each place of production will have a uniform means of evaluating the acceptability of material. The lot standards are stated in terms of acceptable quality level (AQL).

The standards for the individual item are usually established in the "Classification of Defects" for the item. The Classification of Defects lists all possible departures of an individual item from specified standards together with the classification of importance of that defect. The Government inspector accepts or rejects entire lots of merchandise on the basis of these explicit standards received from higher authorities both for the individual unit and for the lot.

Any sampling inspection involves risks of error in judging the quality of lots of material. These risks are given in the operating characteristic curve (OC curve) for each sampling plan. Risks of sampling are held to predetermined values which are taken as calculated risks and can be made as small

Lot size	Inspection levels		
	I	II	III
2 to 8	A	A	C
9 to 15	A	B	D
16 to 25	B	C	E
26 to 40	B	D	F
41 to 65	C	E	G
66 to 110	D	F	H
111 to 180	E	G	I
181 to 300	F	H	J
301 to 500	G	I	K
501 to 800	H	J	L
801 to 1,300	I	K	L
1,301 to 3,200	J	L	M
3,201 to 8,000	L	M	N
8,001 to 22,000	M	N	O
22,001 to 110,000	N	O	P
110,001 to 550,000	O	P	Q
550,001 and over	P	Q	Q

Fig. 1. Code letters indicate table to be used for specified lot size.

as required, consistent with economy. The unavoidable risks of sampling are offset to some extent by the provisions for tightened and reduced inspection imposed by the inspector when the process average departs from the AQL.

Straightforward System

In actual use, the system for inspection is straightforward. A Government inspector presented with a lot of material by a contractor has only to determine the acceptable quality levels from the purchase contract, specification, or other instruction. He then consults MIL STD 105A to determine the size of sample to select from the lot and the acceptance and rejection numbers.

He then proceeds to inspect each unit of the sample selected in accordance with the Classification of Defects for the item. Each unit is classed as defective or nondefective for each class of defects: that is, for critical, major, and minor defects. The inspector accepts the lot if the number of defectives of each type is less or equal to the corresponding acceptance number, and rejects the lot otherwise.

For example, if an inspection lot of 5,000 items is offered for inspection and the AQL for major defectives is given as one per cent and the AQL for minor defectives is given as 2.5 per cent, the inspector determines from Table III of MIL STD 105A (see Fig. 1) at the normal inspection level that tables of code letter "M" apply.

The "M" tables (see Fig. 2) indicate for single sampling that a sample of 225 units should be selected at random from the lot. For the major AQL of one per cent, the acceptance number is five and the rejection number is six. For the minor AQL of 2.5 per cent, the acceptance number is 11 and the rejection number 12.

The inspector then accepts the lot if there are 5 or fewer major defectives, and 11 or fewer minor defectives; or rejects the lot for major defectives, minor defectives, or both, if there are more than 5 majors or 11 minors, or both.

In the event of rejection the entire lot is returned to the contractor for screening and possible repair of defective material. As a resubmitted lot it is usually inspected upon resubmission for only that class of defects for which it was rejected. If critical defects are included in the Classification of Defects the standard does not specify an exact procedure. The Bureau of Ordnance procedure is to inspect each unit of the sample for criticals and accept the lot if no criticals are observed. Regardless of lot size, a minimum sample of 150 is specified for critical defects.

This basic system is made more flexible although somewhat more complicated by different mechanics of sample selection in single, double, and multiple sampling plans, by provisions for different inspection levels based on economy versus risk, and by provisions for tightened and reduced inspection based upon quality of product previously submitted. These provisions in the new standard and the changes made from the previous standard are summarized as follows:

Sampling Plans

The new standard, like the old, has provision for the use of single, double, or multiple sampling plans for normal and reduced inspection. Single sampling is simplest to administer, has no variation in sample size from one lot to another of the same size, but requires the largest average sample. Multiple sampling is more difficult to administer, varies widely from lot to lot, but for most lot qualities has the smallest average sample—frequently being half the required single sample. Double sampling falls in between on all three counts.

Ordinarily the single-sampling plans will be used for routine line inspection in which the total cost of inspection is not closely related to the number of items inspected.

On the other hand, multiple sampling will usually be selected by the inspector for those inspection jobs in which the cost of inspecting each item is large, where the cost of inspection depends largely upon the number of units, or where the inspection load is variable as in incoming or receiving inspection.

Double sampling is generally used in those situations where there is no clear advantage to single or multiple sampling and where the psychological feeling that double sampling involves a "second chance" carries weight with the inspector.

Three Levels

The new standard contains three inspection levels in contrast to the five levels contained in its predecessor. Level II in the new standard is intended for normal inspection and is comparable to Level III of the old standard. Level I is for smaller sample sizes (and greater sampling risks) when the cost of inspection appears to require it. It is comparable to Level I of the former standard in requiring about half the amount of normal inspection, and Level III is comparable to the old Level V, requiring

about twice normal inspection. The purpose of the inspection levels is to provide the contracting or procuring agency some flexibility in determining the amount of inspection required. Usually Level I is used for destruction tests and where the cost of inspecting an item is high.

Decisions to use tightened or reduced inspection, except in the case of first inspection under a new contract, are made by the inspector on the basis of process-average information. The new tables are mechanically easier to use for tightened and reduced inspection than those of the old standard. They are also less severe in the case of tightened inspection and more extensively reduced under reduced inspection.

These provisions for tightened and reduced inspection exhibit an important feature of the statistical quality control philosophy underlying the system of inspection, since the decision to accept or reject any given lot on the basis of average lot standards can best be made after a summary of past inspection data.

Tightened Inspection

The purpose of tightened inspection is to reduce the consumer's risk of accepting poor lots and to force quality improvement in those cases where the contractor has not met the average quality level required. Tightened inspection is mandatory when the process average (usually calculated as the average per cent defective of the first samples from the preceding ten lots) for a class of defects exceeds the limits given in Table II of MIL STD 105A.

These limits are somewhat tighter than the corresponding limits of the old standard since they are calculated from the point AQL rather than from the top of the AQL band as in the old standard. On the other hand, tightened inspection itself is somewhat less rigorous in the new standard than in the old, for it designates tables used normally for one AQL class higher rather than two classes higher as in the old standard. Furthermore, the tables provide directly for tightened inspection whereas the previous standard merely specified a procedure using the normal tables.

The new form is not only somewhat simpler for the inspector to follow but also removes one of the logical contradictions previously involved between the definition of the AQL and the concept of tightened inspection. Since the previous definition of AQL was directly related to the sampling plan used, the earlier procedure for going to a different sampling plan under tightened inspection actually changed the AQL.

The purpose of reduced inspection is to decrease the amount of inspection required where past experience, as shown by process-average information, has shown a significantly better quality than that required. Under the new standards, the limits of process average as given in Table II for utilizing reduced inspection are not so high as previously used, since the limits are calculated from the AQL point rather than from the lower end of the AQL band.

Under the new standard, reduced inspection also entails a sample approximately one-fifth that normally required, whereas under the old system reduced inspection amounted to about one-half the normal inspection.

The new standard includes tables for inspection under defects per 100 units inspection. This is appropriate for inspection of rolls of wire, radio sets, jeeps, and similar items where one or more defects are expected in each item. The new tables, therefore, go beyond the old limit of 6.4 per cent defective (or 6.4 defects per 100 units excepting the overlap of units containing more than one defect) to the new upper limit of 1000.0 defects per 100 units. The defects per 100 unit tables are a straightforward extension of the percentage-defective tables to higher AQL values and to smaller lot sizes.

Lower AQL values may be used interchangeably for defects per 100 units or percentage defective inspection. The new tables include lot size ranges from 2 to 8, 9 to 15, and 16 to 25 in contrast with the smallest lot range of 25 or less in the old tables.

AQL Values

AQL values are given as .035, .065, .1, .15, .25, .40, .65, 1.0, 1.5, 2.5, 4.0, 6.5, in the new standard and these will be used instead of the AQL bands .024-.035, .035-.06, .06-.12, .12-.17, .17-.22, .22-.32, .32-.65, .65-1.2, 1.2-2.2, 2.2-3.2, 3.2-4.4, and 4.4-6.4, respectively, when specified as of the old standard.

The new progression of AQL's is more systematic than the old throughout the tables, and this makes possible a consistent extension of the tables to the high values required for defects per 100 units. Table I of the new Standard gives the band in which the point AQL's apply. A parallel tabulation will quickly show that the new tables for lots of 500 through 22,000 are almost identical to the old with the exception of those with a zero acceptance number.

The new definition of AQL is "a nominal value, specified for a given group of defects of a product" in contrast with the old definition as "the percentage of defective items in an inspection lot such that the sampling plan

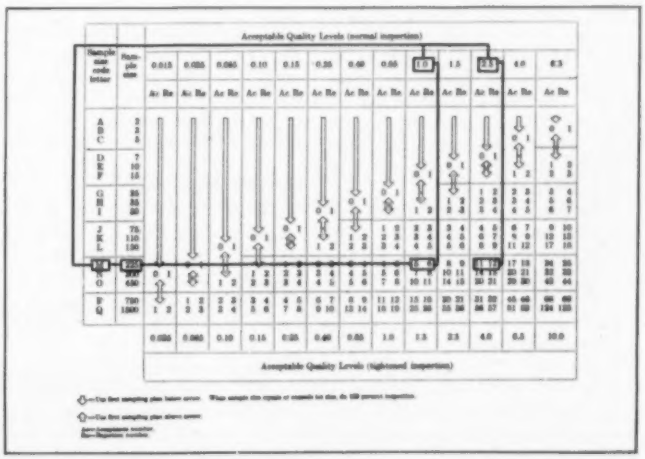

Fig. 2. Part of master table for normal and tightened inspection.

will result in the acceptance of ninety-five per cent of submitted inspection lots containing that percentage of defective items." The two definitions are alike in that they provide an index to sampling plans such that the chance of rejecting material of AQL quality is in the neighborhood of five per cent.

However in the new tables this probability of rejecting lots of AQL quality decreases as the sample size increases, and hence for larger lots of satisfactory quality the probability of rejection due to sampling errors is generally slightly smaller than under the older tables.

Sampling plans with zero acceptance number are tighter under the new standards than under the old, since the producer's risk associated with these plans tended to be disproportionately low in the old tables.

Tables Condensed

The new tables are presented in more condensed form than in the old. The charts showing the comparative operating characteristic curves for single sampling plans are presented collectively rather than on separate pages as under the old tables.

Also the charts show only the operating-characteristic curve for the single sampling plan, a curve which is approximately matched by the parallel in double and sequential sampling plans.

In Navy Bureau of Ordnance practice, instructions to inspectors are issued at the time of assignment of inspection cognizance on a production contract. These instructions indicate whether sampling inspection on the basis of MIL STD 105A shall be used in acceptance, furnishes the classification of defects for the item if available, and assigns the AQL's appropriate for the item. These instructions also direct inspectors to submit weekly reports of inspection on Form 1896.

Classifications of defects have been prepared by the Bureau's design agencies for all new items for the past several years. These classifications, therefore, represent the designers' interpretation of the importance of departures from specified dimensions or characteristics. The classifications are sent to the inspector along with drawings, specifications, and other instructions pertaining to the item under contract.

When classifications of defects are not available for an item, presumably an old design brought back into production, the design agency may construct the classification or the inspector may be requested to make a tentative classification of defects based upon his interpretation of the design requirements. This tentative classification is then reviewed by the Bureau and, if approved, becomes a final classification.

> **"Industry will find the new sampling tables more general and somewhat easier in application than their predecessors."**

Once a classification has been developed for an item it is thereupon used in all production contracts involving that item. Ultimately, classifications of defects will be available for all applicable items prior to procurement.

AQL's are usually established in the instructions to inspectors. These quality standards for lot of the item in contract are established with one eye on the service requirements for the item quality and the other on the industrial ability to meet that quality as shown by experience.

In practice, however, a satisfactory compromise with respect to both requirements appears in the usual assignment of an AQL of one per cent for major and an AQL of 2.5 per cent for minor defectives. For critical defective, an AQL of at least 0.1 per cent is derived from the usual critical sampling procedures. These customary AQL's are changed when the service needs for item quality require or when production experience shows that higher standards can easily be attained without additional production expense.

Changes Permanent

Changes in the AQL for an item indicated by the Bureau are essentially permanent in contrast with temporary changes of a similar kind involved in the imposition of tightened and reduced inspection by the inspector on the basis of process averages.

Instructions to inspectors issued at the time of cognizance assignment require the submission of weekly inspection reports (Form 1896) on all items under standard inspection. The weekly reports are reviewed for accuracy and completeness, are tabulated on IBM cards, and are summarized to provide a basis for assuring general compliance with established AQL's, for judging consistency of inspector's action, for making quality comparisions on the same items between different contractors, and for building a sound experience basis on which to establish or change AQL's for each type of product.

Standard inspection generally does not apply to items under developmental contracts or to complex items procured in small volume. For complex items the preparation of classification of defects for each piece-part and subassembly as it flows into production assembly appears unduly cumbersome; hence attention is directed to specifying the fewest items of inspection through which final product quality can be assured.

It is not unlikely that standard inspection in the future will tend to follow in the direction of complex-item practice.

Inspection Practical

The practical nature of standard acceptance inspection has been widely recognized throughout industry since World War II. Leading companies established acceptance inspection systems utilizing the sampling tables and terminology of JAN STD 105. This use of standard tables has been implemented and supported by the growth of statistical quality control in industry. The large and enthusiastic American Society for Quality Control is in large part responsible for this growth. Industry will find the new sampling tables of MIL STD 105A more general and somewhat easier in application than their predecessors. It is likely that the use of these tables both for subcontracts and commercial items will increase as defense production increases, prime contractors finding it both economical and necessary to insure the quality of subcontracted items in order to meet quality requirements expected of them.

Defense Aid

Industrial usage of standard inspection in past years is thus in itself an important part of defense preparation, for it provides a basis of mutual understanding of the desirable features of standard inspection so necessary for rapid extension.

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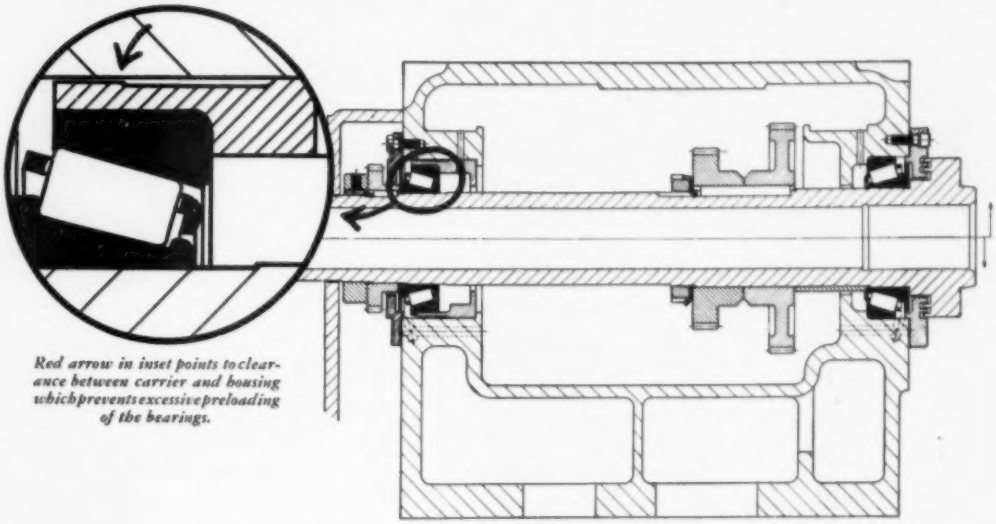

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Photo by Maslowski from National Audubon Society

Match wits with Mustela

Meet *Mustela longicauda,* the long-tailed weasel. After he puts away the rest of that rabbit, his next objective may be some unlucky farmer's henhouse. There he can kill to his heart's content, slashing the throats of a score or more hens before his blood lust is sated.

No doubt about it—he's a predator. The sportsman can have a good time matching wits with *Mustela,* for the weasel knows all the tricks of flight and concealment. Don't try to eliminate the weasel in your area completely, however, for he also helps maintain nature's balance by keeping field mice and rats in check. See your local game regulations, too, before shooting the weasel.

Besides controlling predators like the weasel, good sportsmen can do their part in conserving our game supplies by joining and actively supporting local and national conservation organizations.

N.R.A. RANGER

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